



VISHAY INTERTECHNOLOGY, INC.

INTERACTIVE

data book

LEADED FIXED FILM RESISTORS

VISHAY

VSE-DB0007-0805

Notes:

1. To navigate:
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One of the World's Largest Manufacturers of
Discrete Semiconductors and Passive Components



VISHAY INTERTECHNOLOGY, INC.



LEADED FIXED FILM RESISTORS

- Metal Film Resistors
- Metal Oxide Resistors
- Metal Glaze Resistors
- Carbon Film Resistors

SEMICONDUCTORS

RECTIFIERS

- Schottky (single, dual)
- Standard, Fast, and Ultra-Fast Recovery (single, dual)
- Bridge
- Superrectifier®
- Sinterglass Avalanche Diodes

HIGH-POWER DIODES AND THYRISTORS

- High-Power Fast-Recovery Diodes
- Phase-Control Thyristors
- Fast Thyristors

SMALL-SIGNAL DIODES

- Schottky and Switching (single, dual)
- Tuner/Capacitance (single, dual)
- Bandswitching
- PIN

ZENER AND SUPPRESSOR DIODES

- Zener (single, dual)
- TVS (TRANSZORB®, Automotive, ESD, Arrays)

FETs

- Low-Voltage TrenchFET® Power MOSFETs
- High-Voltage TrenchFET® Power MOSFETs
- High-Voltage Planar MOSFETs
- JFETs

RF TRANSISTORS

- Bipolar Transistors (AF and RF)
- Dual Gate MOSFETs
- MOSMICs®

OPTOELECTRONICS

- IR Emitters and Detectors, and IR Receiver Modules
- Optocouplers and Solid-State Relays
- Optical Sensors
- LEDs and 7-Segment Displays
- Infrared Data Transceiver Modules
- Custom Products

ICs

- Power ICs
- Analog Switches
- RF Transceivers and Receiver Modules
- ICs for Optoelectronics

MODULES

- Power Modules (contain power diodes, thyristors, MOSFETs, IGBTs)
- DC/DC Converters

PASSIVE COMPONENTS

RESISTIVE PRODUCTS

- Foil Resistors
- Film Resistors
 - Metal Film Resistors
 - Thin Film Resistors
 - Thick Film Resistors
 - Metal Oxide Film Resistors
 - Carbon Film Resistors
- Wirewound Resistors
- Power Metal Strip® Resistors
- Chip Fuses
- Variable Resistors
 - Cermet Variable Resistors
 - Wirewound Variable Resistors
 - Conductive Plastic Variable Resistors
- Networks/Arrays
- Non-Linear Resistors
 - NTC Thermistors
 - PTC Thermistors
 - Varistors

MAGNETICS

- Inductors
- Transformers

CAPACITORS

- Tantalum Capacitors
 - Molded Chip Tantalum Capacitors
 - Coated Chip Tantalum Capacitors
 - Solid Through-Hole Tantalum Capacitors
 - Wet Tantalum Capacitors
- Ceramic Capacitors
 - Multilayer Chip Capacitors
 - Disc Capacitors
- Film Capacitors
- Power Capacitors
- Heavy-Current Capacitors
- Aluminum Capacitors
- Silicon RF Capacitors

STRAIN GAGE TRANSDUCERS AND STRESS ANALYSIS SYSTEMS

- PhotoStress®
- Strain Gages
- Load Cells
- Force Transducers
- Instruments
- Weighing Systems
- Specialized Strain Gage Systems

Leaded Fixed Film Resistors

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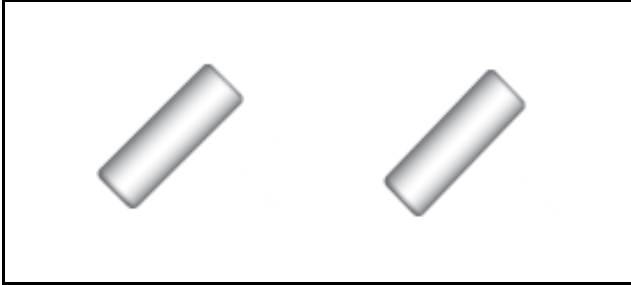
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Leaded Fixed Film Resistors

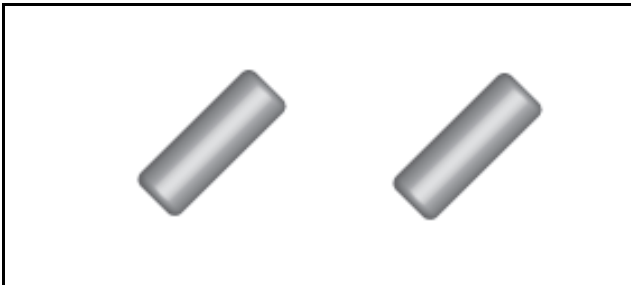
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Manufacturing Process for Fixed Film Resistors



SUBSTRATE

High grade ceramics or glass are used for the substrate to ensure good heat dissipation and electrical performance; various sizes of blanks are used according to the rated power and style of resistor to be manufactured.

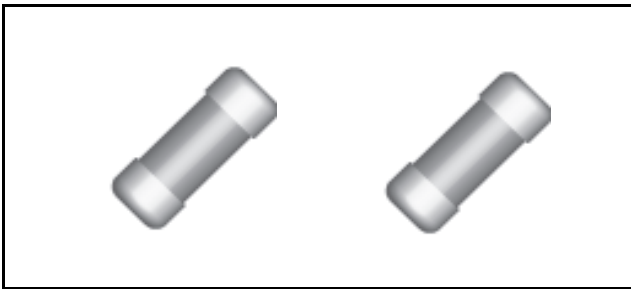


RESISTIVE FILM

The metal film (NiCr) is deposited on the substrate using a vacuum evaporation process at high temperature. In special circumstances NiCu films are deposited electrolytically.

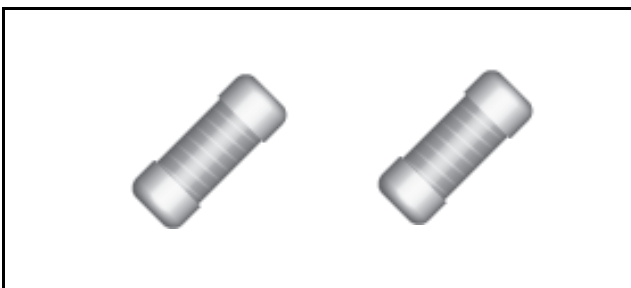
The tin oxide film (SnO_2) is deposited on the substrate using an evaporation process at high temperature.

The carbon film (C) is deposited on the substrate using a hydrocarbon thermal cracking process.



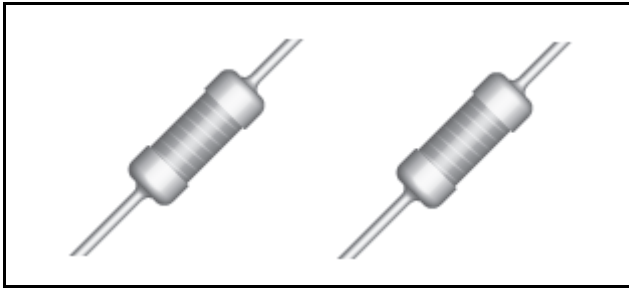
CUPPING

Metal caps are force-fitted on the end of the coated substrate which give minimum contact resistance even in the most severe environments.



SPIRALLING

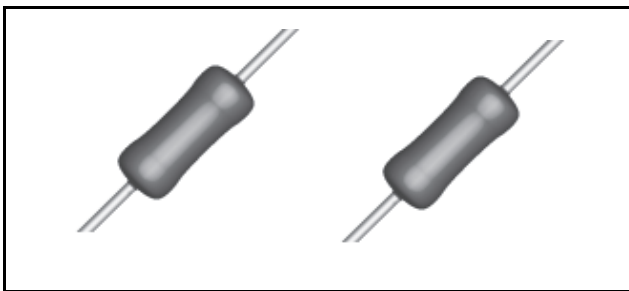
The final resistance value is achieved by cutting a helical groove in the film (mechanically or by laser beam). Statistical methods are used to maintain process control.



LEAD ATTACH

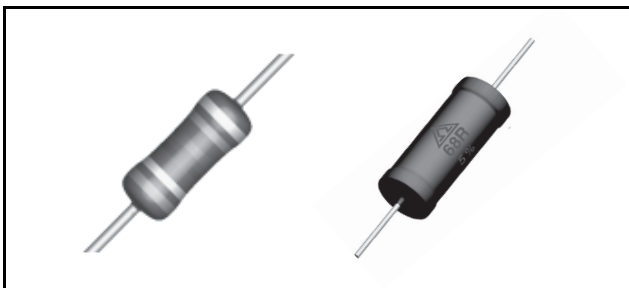
The leads are electrically welded to each cup.

The lead material is high conductivity copper, coated with tin alloy to ensure good solderability.



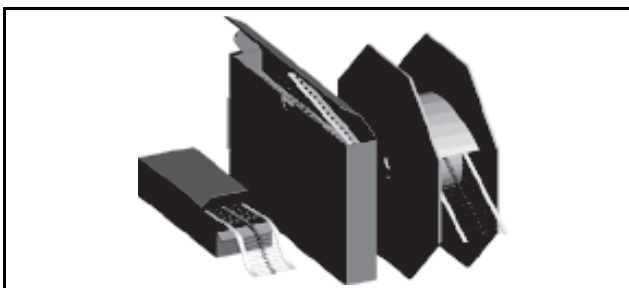
ENCAPSULATION

The resistors are encapsulated to give protection from the environment. Depending upon the style they may be encapsulated in lacquer, high temperature cement, by molding or by powder coating.



MARKING

Each resistor is marked with a color code or print mark to show resistance value and tolerance. Some types are also marked to show model and temperature coefficient.



PACKAGING

Most standard resistors are available taped in boxes or on reels.

Vishay Angstrom Hermetically-Sealed Metal Film Resistors

PRODUCT TECHNOLOGY

Hermeticity is the solution

- Moisture is one of the main factors in resistor failure and can cause open circuits and out of tolerance conditions. Vishay Angstrom hermetically sealed resistors are moisture proof.
- Obtain the excellent electrical specification of Nichrome without concern for performance degradation. No need to degrade to Tantalum Nitride (replaces RNC and commercial molded or conformal metal film product where moisture issues are a concern).
- Use in hostile environments. Corrosive environments and atmospheres have no effect on the resistor. Each resistor is tested with an external force of 3000 PSI. Excellent for chemical and other process environments as well as saltwater, high temperatures and space.
- The resistor element is totally protected, but can be viewed at any time.

Other considerations

- “S” Level reliability demonstrated - better than 0.001 %/ 1000 hours failure rate, capable of passing T (Space) failure level. Absolutely no out gassing.
- The resistor minimizes any thermal EMF as it is spiralled across its entire body length. Resistance, and therefore self heating, is uniformly distributed over the length. No thinning of the film is done as all adjustments are made by laser spiral trimming.

PRODUCT CONSTRUCTION

Homogeneous metal film

Sputtered deposition produces a uniform homogeneous metal film on the substrate. This provides a core blank which has a specific resistivity and a temperature coefficient of resistance, which is virtually free of localized hot spots, assuring unsurpassed long term stability characteristics.

Metal end caps and leads

Gold-plated nickel leads welded to the end caps, which are precision fitted over the core ends, provide the most reliable method of interconnects available. Hot solder-dipped nickel leads are available.

Adjusting to value

The metal film of the basic resistor is now helixed to the required value by a laser beam.

Hermetic enclosure

Following helixing, the hermetic seal is established by fusing the clear glass sleeve to kovar bellows-type discs in a dry helium atmosphere, which are in turn simultaneously brazed to the resistor leads. The helium serves as an inert atmosphere for the resistor element and as a means for determining the seal effectiveness (which has been consistently demonstrated to have a leak rate of less than 1×10^{-8} cc/s) After marking for identification, a clear varnish is applied to the enclosure.

Tight tolerance calibration

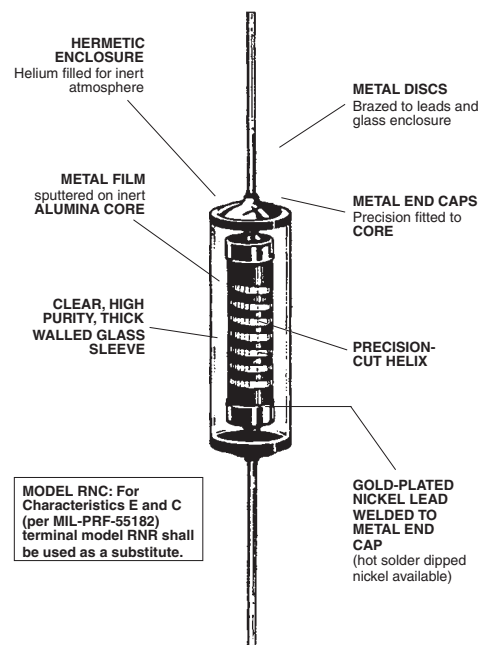
Because of the clear glass enclosure, tight tolerance resistors can be calibrated using laser technology, after the resistor is completely sealed in its own inert environment. This calibration technique provides added assurance of long term stability.

Pre-conditioning and testing

As a high reliability part, the RNR/RNN resistor is subjected to pre-conditioning and acceptance testing in accordance with MIL-PRF-55182. “Improved Performance Testing” is available to meet customer specifications or application requirements.

Quality control

All manufacturing, inspections and testing are closely monitored by exacting in-process controls audited by Quality Control and Reliability personnel.



RATED RESISTANCE

Resistance value indicated upon the resistor and the label.

TOLERANCE

Permitted variation of the rated resistance value, usually expressed as a percentage of that value.

RATED DISSIPATION

Maximum load at a well-defined ambient temperature [Tu], e.g. [Tu] = 70 °C.

STANDARD POWER RATING (Pw)

Maximum permitted load at a defined ambient temperature which ensures that resistance stability limit in the relevant specification is not exceeded.

TEMPERATURE COEFFICIENT

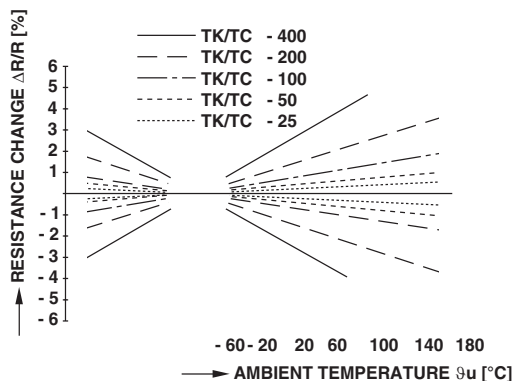
The TC specifies the permissible change of the resistance value depending on temperature and can be described by the following equation:

$$C (10^{-6}/K) = \frac{R - R_{20}}{R_{20} \times \Delta\theta} \times 10^{-6}$$

at which $\Delta\theta$ is the difference between 20 °C and the corresponding ambient temperature.

For metal film and metal oxide film resistors, usually the TC is specified as a limiting line at 20 °C and the ambient temperatures (see diagram).

The temperature resistance curves of metal film resistors (MK) show a slight slope, those of metal oxide film resistors (WK) show a larger one. Measured according to DIN specification.



Carbon film resistors have a negative TC depending on the resistance value. See the appropriate data sheets. In film resistors with a high positive TC, the TC must be taken into consideration at the circuit dimensioning with regard to the permissible load P_{40} respective P_{70} .

The maximum permissible increase of the resistance value by the TC in case of electric load can be determined by way of the maximum permissible temperature of the film temperature.

The change of the resistance value is calculated by:

$$R_{\theta_{max}} = R_N [1 + (\theta_{max} - 20 \text{ °C}) \times TC_{max}]$$

Consequently the maximum permissible current respective the maximum permissible voltage for P_{40} respective P_{70} can be calculated by $R_{\theta_{max}}$.

LIMITING ELEMENT VOLTAGE

Maximum d.c. or a.c. effective voltage which can be applied continuously to the terminations of a resistor.

INSULATION VOLTAGE

Maximum peak voltage which may be applied under continuous operating conditions between the resistor terminations and any conducting mounting surface.

VOLTAGE PROOF

Minimum value of a d.c. voltage or peak of an a.c. voltage resulting from performing the voltage test for 1 minute using the V-block method according to IEC60115-1.

INSULATION RESISTANCE

Electrical resistance value of the coating measured between the terminations of the resistor and applied V-block according to IEC60115-1.

THERMAL RESISTANCE

Quotient of maximum increase of the surface temperature and electric power under well defined test conditions. Under electrical load a film resistor generates heat which increases the film temperature. At the same time heat is dissipated to the environment, so that with constant electrical load and constant convection a thermal balance appears between the

heat, generated by the electrical load, and the heat lost by convection.

These proportions are characterized by the thermal resistance. The thermal resistance is defined by the mechanical dimensions of a resistor, the heat dissipation by the wire leads as well as the convection, radiation and the mounting of the resistor.

The thermal resistance R_{th} is defined as follows:

$$R_{th} = \frac{\vartheta_s - \vartheta_u}{P} = \frac{\vartheta_{\dot{u}}}{P}$$

ϑ_s [°C] = film temperature

ϑ_u [°C] = ambient temperature

$\vartheta_{\dot{u}}$ [°C] = temperature rise

P [°C] = load

The thermal resistance measurement is made under defined conditions according to DIN 44 050.

Using this equation the maximum power rating of:

$$P_{max.} = \frac{\vartheta_s - \vartheta_u}{R_{th}} \text{ is the result.}$$

Thus the maximum permissible power rating $P_{max.}$ is dependent on the maximum permissible film temperature, the ambient temperature ϑ_u , and the thermal resistance.

DERATING

Boundary curve of maximum rated power of the resistor under continuous operation at different ambient temperatures.

FAILURE RATE

Number of components failed under well defined test conditions, divided by the number of components used and the duration of the test. The failure rate is valid for the total resistance range with a defined confidence level. In operation with lower surface temperatures the failure rate is reduced by several decades.

CATEGORY TEMPERATURE RANGE

Range of ambient temperatures for which the resistor is designed to operate continuously.

CURRENT NOISE LEVEL

Noise level caused by a d.c. load referred to a frequency decade, expressed in $\mu\text{V}/\text{V}$. The current noise level E_1 in μV is that portion of the noise voltage on the terminals of a fixed resistor, that arises from DC current in a resistor in addition to the thermal noise voltage.

The relative noise voltage, expressed in $\mu\text{V}/\text{V}$, is independent of the applied DC voltage $U_{\text{=}}$.

The current noise voltage E_1 in μV is that portion of the noise voltage on the terminals of a fixed resistor, that arises from DC current in a resistor in addition to the thermal noise voltage: Normally the thermal noise voltage is negligible.

The relative noise voltage, expressed in $\mu\text{V}/\text{V}$, is independent of the applied DC voltage $U_{\text{=}}$.

NON-LINEARITY

The harmonic index and the voltage coefficient of resistors are criteria for the non-linearity of the current voltage characteristic. Distortion of the applied voltage occurs under AC loading, building up harmonics due to the curvature of the resistance characteristic.

The harmonic index is defined as the logarithm of the ratio of the fundamental U_1 to the 3rd harmonic E_3 .

It is specified in dB:

$$A_3 = 20 \times \lg \frac{U_1}{E_3} \text{ [dB]}$$

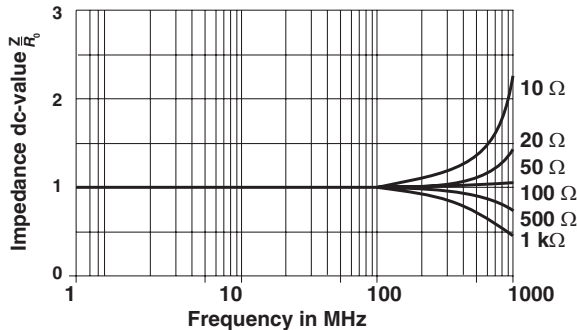
Measurements are according to IEC60440.

TEMPERATURE RISE

Temperature difference between ambient temperature and maximum surface temperature of the element at a defined load, measured according to DIN 44050.

HIGH FREQUENCY CHARACTERISTICS

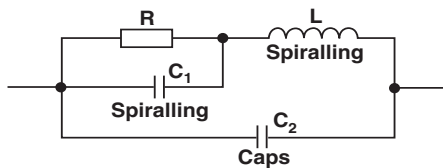
Fixed film resistors show a capacitive and inductive reactance at high frequencies in addition to the pure ohmic resistance because of their structure. The inductive component can be kept low for special styles.



TYPICAL HF-CHARACTERISTICS OF A FIXED FILM RESISTOR

For high frequency applications a special HF-version can be supplied for all cylindrical sizes in the value range from 10 Ω to 1 kΩ. In HF versions the parasitic reactive components are very small until up to the high megacycles range. Generally as far as HF characteristics on film resistors are concerned, we noted that up to approximately 10 MHz they operate as real resistors. By increasing the frequency, more and more reactive components can be produced.

See diagram below:



For resistors with values > 1K the capacitive part is already clearly predominant and is increasing more than the inductive part, with higher ohmic values. A measurable improvement by special trimming is not possible here. Generally, the following classification can be made;

1. Resistors < 100 Ω are all inductive.
2. Resistors between 100 Ω and 470 Ω are “almost real”.
3. Resistors > 470 Ω are capacitive.

PULSE CHARACTERISTICS

Capability of withstanding short duration electrical impulses where the power during the impulse exceeds the rated power of the resistor.

When a film resistor is electrically loaded by impulses the following points have to be observed:

1. The maximum pulse load permissible P_{max} depends on the duration t_i . The same applies to the maximum pulse voltage permissible \hat{U}_{max} .
2. The average load P may not exceed the corresponding nominal load. For resistors with resistance values higher than the critical value, the nominal value is determined by the critical value and the maximum operating voltage permissible.

Required:

$$P = \frac{1}{t_p R} \int_{t_1}^{t_2} U^2(t) dt \leq P_g$$

Explanations:

R = nominal value

t_p = period of time

$U(t)$ = pulse voltage

P = nominal load of the resistor for the ambient temp. ϑ

$t_2 - t_1$ = pulse duration t_i

3. It has to be noted if this is a question of an impulse sequence or of single-stop pulses (switching-on processes). Approximate values for the load with rectangular pulses for the respective versions are stated in the corresponding chapters of the catalog. All other pulses have to be converted to rectangular pulses which show the same energy content and the same pulse voltage.

Example: Exponential pulse:

$$\frac{\tau \hat{U}_s^2}{2R} = t_i \frac{\hat{U}_s^2}{R} \text{ e.g. } t_i = \frac{\tau}{2}$$

Explanations:

τ = time constant of the exponential pulse

t_i = pulse duration of the rectangular pulse

\hat{U}_s = peak voltage

R = nominal value of the resistor

The maximum pulse voltages permissible U_{max} are also stated. The permissible pulse loads have been fixed in such a way that the appearing changes in resistance values are comparable to those stated for the electrical long time load according to IEC60115-1.

STABILITY

The change of the resistance values at certain loads and ambient temperatures can be gathered from the stability nomogram which consists of 4 diagrams which can also be used by themselves.

The stability nomograms for the different versions can be seen on the appropriate data sheets. In addition, the limiting values stated in the data sheets, such as maximum load, surface temperature etc. have to be observed.

The following examples show how to use a nomogram:

Example 1.

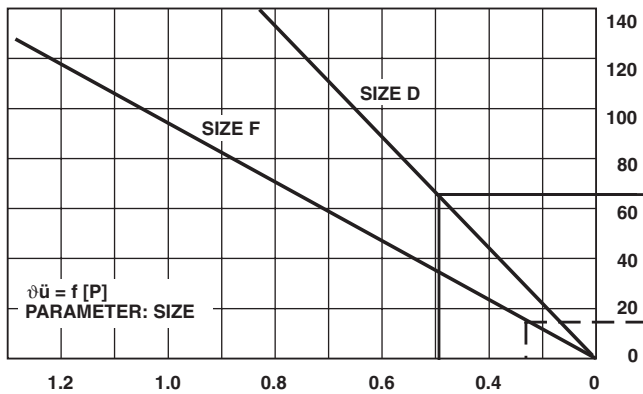
Known: size D, $R = 1 \text{ k}\Omega$

$P = 0.5 \text{ W}$, $U_{gr} = 350 \text{ V}$, $t = 5000 \text{ hours}$, $\vartheta_u = 70 \text{ }^\circ\text{C}$

Unknown: $\Delta R/R$ after 5000 hours

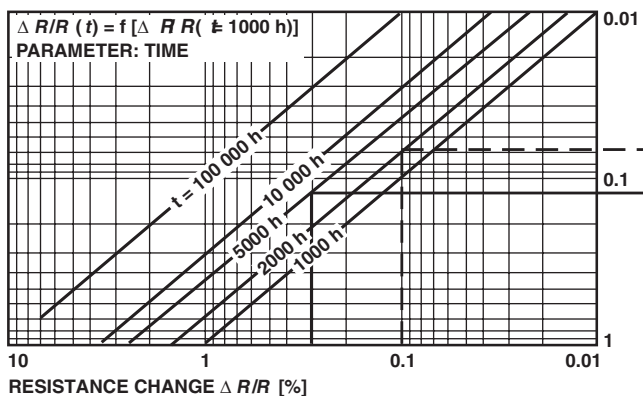
From diagram A: we receive a temperature rise of $\vartheta_u = 65 \text{ }^\circ\text{C}$ for size D at $P = 0.5 \text{ W}$

Diagram A



LOAD P [W]

Diagram C



STABILITY NOMOGRAM TYPICAL VALUES

From diagram B: a surface temperature of $135 \text{ }^\circ\text{C}$ can be gained for $\vartheta_u = 70 \text{ }^\circ\text{C}$

From diagram D: a $\Delta R/R$ after 1000 hours of 0.13 % can be gathered for a surface temperature of $135 \text{ }^\circ\text{C}$ of a $1 \text{ k}\Omega$ resistor.

After 5000 hours $\Delta R/R = 0.3 \text{ }%$ according to diagram C. Please see the solid line in the nomogram.

Example 2.

Known: size F, $R = 1 \text{ M}\Omega$

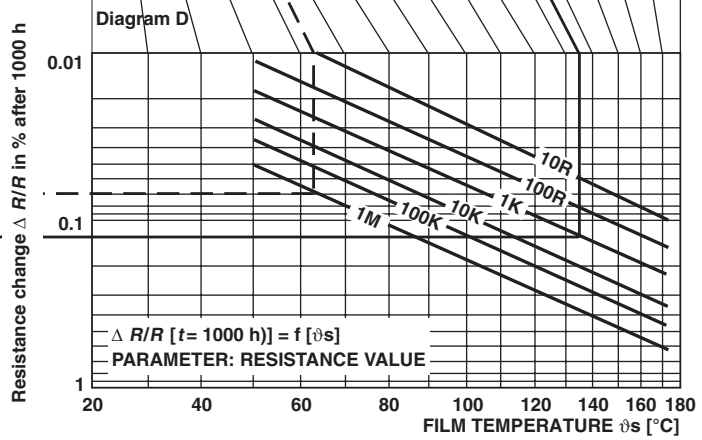
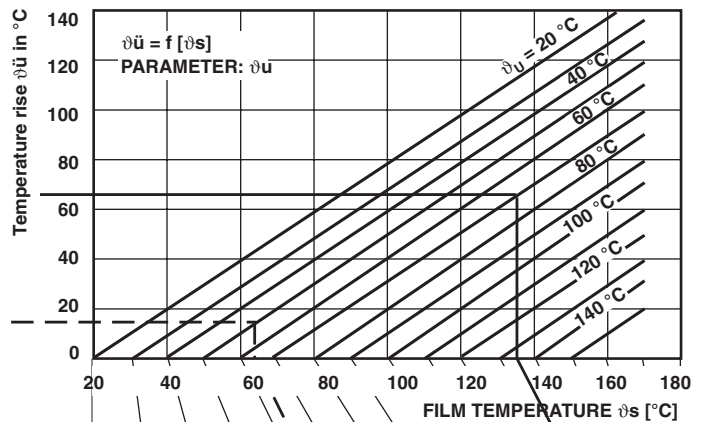
$P_{70} = 1.5 \text{ W}$, $U_{gr} = 500 \text{ V}$, $t = 2000 \text{ hours}$, $\vartheta_u = 50 \text{ }^\circ\text{C}$

Unknown: $\Delta R/R$ after 2000 hours

For $R = 1 \text{ M}\Omega$ formula below applies.

$$P = \frac{U_{gr}^2}{R} = 0.25 \text{ W as } U = PR > U_{gr}$$

Diagram B



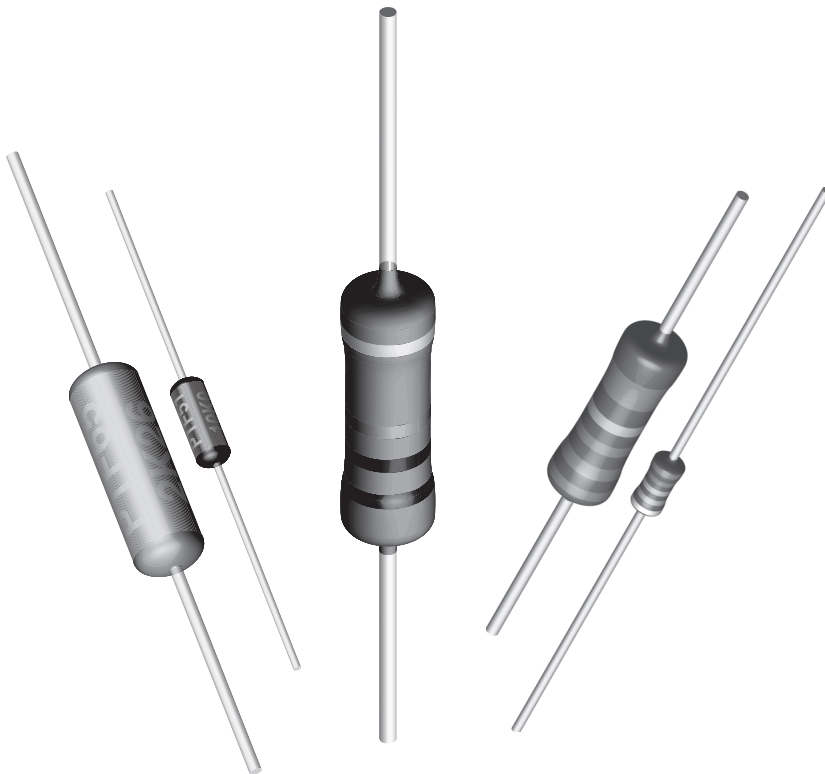


Metal Film Resistors

Low TCR

•
Excellent Stability

•
Tight Tolerance



Contents

CCF07	12
CCF50	14
CCF55, CCF60	16
CMF Industrial	18
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Metal Film Resistors, Industrial, ± 2 % and ± 5 % Tolerance



FEATURES

- 0.25 W at + 70 °C power rating
Dual rated for 0.5 W
- ± 2 % and ± 5 % tolerance
- ± 100 ppm/°C and ± 200 ppm/°C temperature coefficient
- Tape and reel packaging for automatic insertion (52.4 mm inside tape spacing per EIA-296-E)
- Flame retardant epoxy conformal coating
- Standard 4 band color code marking for ease of identification after mounting
- Lead (Pb)-free version is RoHS compliant



RoHS*
COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS

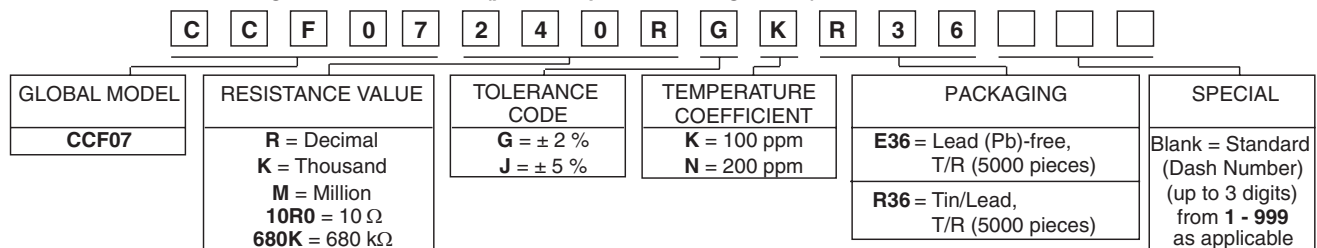
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{70\text{ }^\circ\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX. V_{\equiv}	TEMPERATURE COEFFICIENT ppm/°C	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
CCF07	CCF-07	0.25/0.5	250	± 100	± 2, ± 5	10R - 1M	24
CCF07	CCF-07	0.25/0.5	250	± 200	± 5	1.1M - 2M	24

TECHNICAL SPECIFICATIONS

PARAMETER	UNIT	CCF07
Rated Dissipation at 70 °C	W	0.25/0.5
Maximum Working Voltage	V_{\equiv}	≤ 250
Insulation Voltage (1 Min)	V_{eff}	500
Dielectric Strength	V_{AC}	450
Insulation Resistance	Ω	≥ 10 ¹¹
Operating Temperature Range	°C	- 65 to + 150
Terminal Strength (Pull Test)	lb	2
Weight	g	0.35 max.

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: CCF07240RGKR36 (preferred part numbering format)

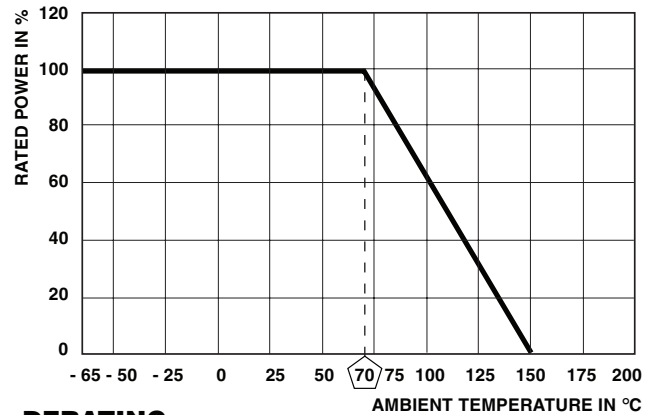
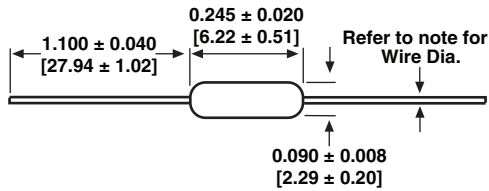


Historical Part Number example: CCF-07241G (will continue to be accepted)



* Pb containing terminations are not RoHS compliant, exemptions may apply

DIMENSIONS in inches [millimeters]



Note:

Wire Dia.

CCF07 (Sn/Pb) = 0.025 ± 0.002 [0.64 \pm 0.05]

CCF07 (Sn) = 0.023 ± 0.002 [0.60 \pm 0.05]

MARKING

- Color band

RESISTANCE VALUES

Vishay Dale Model CCF07 is available in the standard 24 resistance values per decade. Values are obtained from the following decade table by multiplying by powers of 10. As an example: 24 can represent 24 Ω , 240 Ω , 2.4 k Ω , 24 k Ω or 240 k Ω .

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

TECHNICAL SPECIFICATIONS

TEST ⁽¹⁾	Max. ΔR (Typical Test Lots)
Thermal Shock	$\pm 1.0\%$
Short Time Overload	$\pm 0.5\%$
Low Temperature Operation	$\pm 0.5\%$
Moisture Resistance	$\pm 1.5\%$
Resistance to Soldering Heat	$\pm 0.5\%$
Shock/Bump	$\pm 0.5\%$
Vibration	$\pm 0.5\%$
Terminal Strength	$\pm 0.5\%$
Dielectric Withstanding Voltage	$\pm 0.5\%$
Life	$\pm 1.5\%$ ⁽²⁾

Notes:

⁽¹⁾ Test Methods per MIL-STD-202G/IEC 600115/DIN EN 140000 (as applicable).

⁽²⁾ Life ΔR is $\pm 2.0\%$ for 1/2 W rating.

Metal Film Resistors, Industrial, ± 1 % and ± 5 % Tolerance



FEATURES

- 0.33 W power rating
- ± 100 ppm/°C standard, ± 50 ppm/°C available upon request
- Superior electrical performance
- Flame retardant epoxy conformal coating
- Standard 4 or 5 band color code marking for ease of identification after mounting
- Tape and reel packaging for automatic insertion (52.4 mm inside tape spacing per EIA-296-E)
- Lead (Pb)-free version is RoHS compliant



RoHS*
COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS							
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{70^{\circ}\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX. V_{\equiv}	TEMPERATURE COEFF. (1) ppm/°C	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
CCF50	CCF-50	0.33	200	± 100	± 1, ± 5	10R - 1M	96 for 1 % 24 for 5 %

Note:

(1) 50 ppm/°C on request

TECHNICAL SPECIFICATIONS		
PARAMETER	UNIT	CCF50
Rated Dissipation at 70 °C	W	0.33
Maximum Working Voltage	V_{\equiv}	≤ 200
Insulation Voltage (1 Min)	V_{eff}	> 500
Dielectric Strength	V_{AC}	450
Insulation Resistance	Ω	≥ 10 ¹¹
Operating Temperature Range	°C	- 65 to + 165
Weight	g	0.11 max.

GLOBAL PART NUMBER INFORMATION

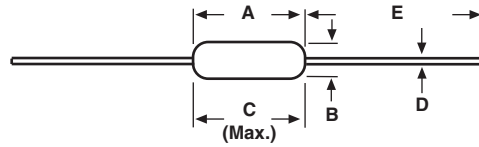
New Global Part Numbering: CCF50301RFK R 3 6 [] [] [] (preferred part numbering format)

C	C	F	5	0	3	0	1	R	F	K	R	3	6	[]	[]	[]
GLOBAL MODEL	RESISTANCE VALUE		TOLERANCE CODE		TEMPERATURE COEFFICIENT		PACKAGING		SPECIAL							
CCF50	R = Decimal K = Thousand M = Million 10R0 = 10 Ω 680K = 680 k Ω 1M00 = 1.0 M Ω		F = ± 1 % J = ± 5 %		H = 50 ppm K = 100 ppm		E36 = Lead (Pb)-free, T/R (5000 pieces) R36 = Tin/Lead, T/R (5000 pieces)		Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable							

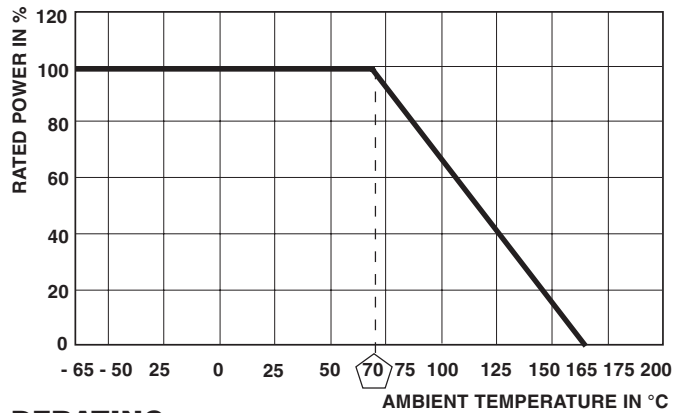
Historical Part Number example: CCF-503010F (will continue to be accepted)

CCF-50	3010	F	R36
HISTORICAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING

* Pb containing terminations are not RoHS compliant, exemptions may apply

DIMENSIONS in inches [millimeters]


DIMENSION	INCHES	MILLIMETERS
A	0.133 ± 0.010	[3.3 \pm 0.025]
B	0.062 ± 0.004	[1.57 \pm 0.10]
C (Max.)	0.143	[3.63]
D	0.020 ± 0.002	[0.51 \pm 0.05]
E	1.125 ± 0.040	[28.58 \pm 1.02]


DERATING
MARKING

- 5 band colorband for $\pm 1\%$
- 4 band colorband for $\pm 5\%$

PERFORMANCE

TEST (1)	TYPICAL ΔR
Thermal Shock	$\pm 0.1\%$
Short Time Overload	$\pm 0.1\%$
Low Temperature Operation	$\pm 0.1\%$
Moisture Resistance	$\pm 0.2\%$
Resistance to Soldering Heat	$\pm 0.05\%$
Shock	$\pm 0.1\%$
Vibration	$\pm 0.05\%$
Life	$\pm 0.5\%$
Terminal Strength	$\pm 0.1\%$
Dielectric Withstanding Voltage	$\pm 0.05\%$

Note:

(1) Tests per MIL-R-10509

Metal Film Resistors, Industrial, ± 1 % Tolerance



FEATURES

- Power Ratings: 1/4, 1/2, 3/4 and 1 W at + 70 °C
- ± 100 ppm/°C temperature coefficient
- Superior electrical performance
- Flame retardant epoxy conformal coating
- Standard 5 band color code marking for ease of identification after mounting
- Tape and reel packaging for automatic insertion (52.4 mm inside tape spacing per EIA-296-E)
- Lead (Pb)-free version is RoHS compliant



RoHS*
COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS

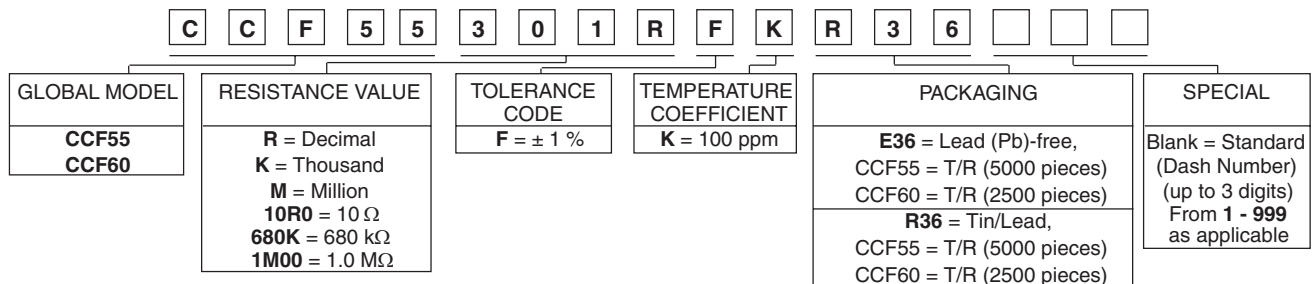
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{70\text{ }^\circ\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX. V_{\equiv}	TEMPERATURE COEFFICIENT ppm/°C	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
CCF55	CCF-55	0.25/0.5	250	± 100	± 1	10R - 3.01M	96
CCF60	CCF-60	0.50/0.75/1.0	500	± 100	± 1	10R - 1M	96

TECHNICAL SPECIFICATIONS

PARAMETER	UNIT	CCF55	CCF60
Rated Dissipation at 70 °C	W	0.25/0.5	0.5/0.75/1.0
Maximum Working Voltage	V_{\equiv}	≤ 250	≤ 500
Insulation Voltage (1 Min)	V_{eff}	500	500
Dielectric Strength	V_{AC}	450	450
Insulation Resistance	Ω	≥ 10 ¹¹	≥ 10 ¹¹
Operating Temperature Range	°C	- 65 to + 165	- 65 to + 165
Terminal Strength (Pull Test)	lb	2	2
Weight	g	0.35 max.	0.75 max.

GLOBAL PART NUMBER INFORMATION

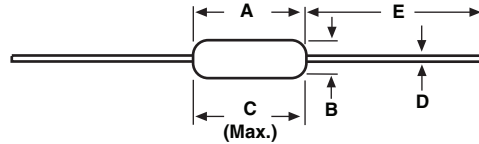
New Global Part Numbering: CCF55301RFKR36 (preferred part numbering format)



Historical Part Number example: CCF-553010F R36 (will continue to be accepted)



* Pb containing terminations are not RoHS compliant, exemptions may apply

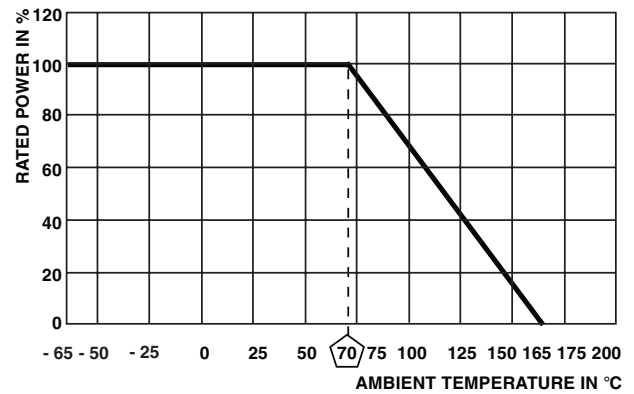
DIMENSIONS in inches [millimeters]


GLOBAL MODEL	A	B	C (Max.)	D	E
CCF55 (Sn/Pb)	0.245 \pm 0.020 [6.22 \pm 0.51]	0.090 \pm 0.008 [2.29 \pm 0.20]	0.265 [6.73]	0.025 \pm 0.002 [0.64 \pm 0.05]	1.100 \pm 0.040 [27.94 \pm 1.02]
CCF55 (Sn)	0.245 \pm 0.020 [6.22 \pm 0.51]	0.090 \pm 0.008 [2.29 \pm 0.20]	0.265 [6.73]	0.023 \pm 0.002 [0.60 \pm 0.05]	1.100 \pm 0.040 [27.94 \pm 1.02]
CCF60	0.344 \pm 0.031 [8.74 \pm 0.79]	0.139 \pm 0.009 [3.53 \pm 0.23]	0.400 [10.16]	0.025 \pm 0.002 [0.64 \pm 0.05]	1.000 \pm 0.040 [25.40 \pm 1.02]

RESISTANCE VALUES

Vishay Dale Models CCF55 and CCF60 are available in the standard 96 resistance values per decade. Values are obtained from the following decade table by multiplying by powers of 10. As an example: 30.1 can represent 30.1 Ω , 301 Ω , 3.01 k Ω , 30.1 k Ω or 301 k Ω .

10.0	14.7	21.5	31.6	46.4	68.1
10.2	15.0	22.1	32.4	47.5	69.8
10.5	15.4	22.6	33.2	48.7	71.5
10.7	15.8	23.2	34.0	49.9	73.2
11.0	16.2	23.7	34.8	51.1	75.0
11.3	16.5	24.3	35.7	52.3	76.8
11.5	16.9	24.9	36.5	53.6	78.7
11.8	17.4	25.5	37.4	54.9	80.6
12.1	17.8	26.1	38.3	56.2	82.5
12.4	18.2	26.7	39.2	57.6	84.5
12.7	18.7	27.4	40.2	59.0	86.6
13.0	19.1	28.0	41.2	60.4	88.7
13.3	19.6	28.7	42.2	61.9	90.9
13.7	20.0	29.4	43.2	63.4	93.1
14.0	20.5	30.1	44.2	64.9	95.3
14.3	21.0	30.9	45.3	66.5	97.6


DERATING
MARKING

- Color band

PERFORMANCE

POWER RATING at + 70 $^{\circ}\text{C}$		
CCF55	1/4 W	1/2 W
CCF60	1/2 W	3/4 W and 1 W
TEST ⁽¹⁾	MAXIMUM ΔR	MAXIMUM ΔR
Thermal Shock	$\pm 0.5\%$	-
Short Time Overload	$\pm 0.5\%$	-
Low Temperature Operation	$\pm 0.5\%$	-
Moisture Resistance	$\pm 1.5\%$	-
Resistance to Soldering Heat	$\pm 0.5\%$	-
Shock/Bump	$\pm 0.5\%$	-
Vibration	$\pm 0.5\%$	-
Life	$\pm 0.5\%$	$\pm 1.0\%$
Terminal Strength	$\pm 0.2\%$	-
Dielectric Withstanding Voltage	$\pm 0.5\%$	-

Note:
⁽¹⁾ Test Methods per MIL-STD-202G/IEC 60115/DIN EN140000 (as applicable).

Metal Film Resistors, Industrial, Precision



FEATURES

- Small size - conformal coated
- Flame retardant epoxy coating
- Controlled temperature coefficient
- Excellent high frequency characteristics
- Exceptionally low noise; typically 0.10 $\mu\text{V/V}$
- Low voltage coefficient to ± 5 ppm/V
- Lead (Pb)-free version is RoHS compliant
- Special tolerance and or TC matching available on request



RoHS*
COMPLIANT

Vishay Dale Model CMF is also available as Military Qualified Styles RN and RL. See appropriate catalog or web page for the MIL-SPEC ratings/attributes. (Except for marking, the Industrial and Military versions are exactly the same. Depending upon stock, military marked parts may be supplied as industrial rated parts).

STANDARD ELECTRICAL SPECIFICATIONS											
GLOBAL MODEL	HISTORICAL MODEL	LIMITING ELEMENT VOLTAGE MAX V \equiv	RESISTANCE RANGE Ω								
			0.1% - 1%	0.1% - 0.5%	1% - 5%	1%	2%, 5%	1%	2%, 5%	1%	2%, 5%
			25 ppm	50 ppm	50 ppm	100 ppm	100 ppm	150 ppm	150 ppm	200 ppm	200 ppm
CMF50	CMF-50	200	10 - 2M5	10 - 2M5	10 - 2M5	10 - 2M5	10 - 2M5	10 - 22M	10 - 22M	10 - 22M	10 - 22M
CMF55	CMF-55	250	10 - 2M5	10 - 2M5	10 - 5M	1 - 22M1	1 - 22M1	R5 - 50M	R5 - 50M	R5 - 50M	R1 - 50M
CMF60	CMF-60	500	10 - 2M5	10 - 2M5	10 - 10M	1 - 10M	1 - 10M	R5 - 10M	R5 - 10M	R5 - 10M	R1 - 10M
CMF65	CMF-65	500	10 - 2M5	10 - 2M5	10 - 10M	1 - 15M	1 - 15M	R5 - 22M	R5 - 22M	R5 - 22M	R1 - 22M
CMF70	CMF-70	500	10 - 2M5	10 - 2M5	10 - 10M	1 - 15M	1 - 15M	1 - 22M	1 - 22M	1 - 22M	1 - 22M
CMF07	CMF-07	250	-	-	-	-	5 - 5M	-	1 - 5M	-	1 - 5M
CMF20	CMF-20	500	-	-	-	-	5 - 10M	-	1 - 10M	-	1 - 10M

COMMERCIAL POWER RATING (see Performance Table)		
WATTAGE	AT + 70 °C	AT + 125 °C
0.05	CMF50	CMF50
0.10	CMF50, CMF55	CMF50, CMF55
0.125	CMF50, CMF55, CMF60	CMF50, CMF55, CMF60, CMF20
0.25	CMF50, CMF55, CMF60, CMF65, CMF70, CMF07	CMF55, CMF60, CMF65, CMF70, CMF20
0.50	CMF55, CMF60, CMF65, CMF70, CMF20	CMF60, CMF65, CMF70, CMF20
0.75	CMF60, CMF65, CMF70, CMF20	CMF65, CMF70
1.0	CMF60, CMF65, CMF70, CMF20	-

Note:

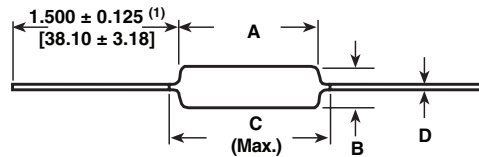
The above table summarizes the more common combinations of power rating, case size and ambient operating temperature that prevail in various Industrial and Military resistor specifications. The "performance" table in ensuing pages qualifies the load life stability under these combinations.

GLOBAL PART NUMBER INFORMATION																	
New Global Part Numbering: CMF55301R00FKRE (preferred part numbering format)																	
C	M	F	5	5	3	0	1	R	0	0	F	K	R	E			
GLOBAL MODEL (see Standard Electrical Specifications table)	RESISTANCE VALUE R = Decimal K = Thousand M = Million R10000 = 0.1 Ω 680K00 = 680 k Ω 1M0000 = 1.0 M Ω	TOLERANCE CODE B = ± 0.1 % C = ± 0.25 % D = ± 0.5 % F = ± 1 % G = ± 2 % J = ± 5 %	TEMPERATURE COEFFICIENT (1) E = 25 ppm H = 50 ppm K = 100 ppm L = 150 ppm N = 200 ppm	PACKAGING EK = Lead (Pb)-free, Bulk EA = Lead (Pb)-free, T/R (Full) EB = Lead (Pb)-free, T/R (1000 pieces) BF = Tin/Lead, Bulk RE = Tin/Lead, T/R (Full) R6 = Tin/Lead, T/R (1000 pieces)	SPECIAL Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable												
Historical Part Number example: CMF-553010FT-1 (will continue to be accepted)																	
CMF-55	3010	F		T-1	R36												
HISTORICAL MODEL	RESISTANCE VALUE	TOLERANCE CODE		TEMP. COEFFICIENT	PACKAGING												

Note:

(1) Tolerances of ± 0.5 % (D), ± 0.25 % (C) and ± 0.1 % (B) are available only in 50 ppm and 25 ppm temperature coefficients.
* Pb containing terminations are not RoHS compliant, exemptions may apply.

DIMENSIONS in inches [millimeters]



GLOBAL MODEL	A	B	C (Max.)	D
CMF50	0.150 ± 0.020 [3.81 ± 0.51]	0.065 ± 0.015 [1.65 ± 0.68]	0.187 [4.75]	0.016 ± 0.002 [0.41 ± 0.05]
CMF55	0.240 ± 0.020 ⁽⁴⁾ [6.10 ± 0.51]	0.090 ± 0.008 [2.29 ± 0.20]	0.278 [7.06] ⁽³⁾	0.025 ± 0.002 [0.64 ± 0.05]
CMF60	0.344 ± 0.031 [8.74 ± 0.79]	0.145 ± 0.015 [3.68 ± 0.38]	0.425 [10.80]	0.025 ± 0.002 ⁽²⁾ [0.64 ± 0.05]
CMF65	0.562 ± 0.031 [14.27 ± 0.79]	0.180 ± 0.015 [4.57 ± 0.38]	0.687 [17.45]	0.025 ± 0.002 [0.64 ± 0.05]
CMF70	0.562 ± 0.031 [14.27 ± 0.79]	0.180 ± 0.015 [4.57 ± 0.38]	0.687 [17.45]	0.032 ± 0.002 [0.81 ± 0.05]
CMF07	0.240 ± 0.020 [6.10 ± 0.51]	0.090 ± 0.008 [2.29 ± 0.20]	0.278 [7.06]	0.025 ± 0.002 [0.64 ± 0.05]
CMF20	0.375 ± 0.040 [9.53 ± 1.02]	0.145 ± 0.015 [3.68 ± 0.38]	0.425 [10.80]	0.032 ± 0.002 [0.81 ± 0.05]

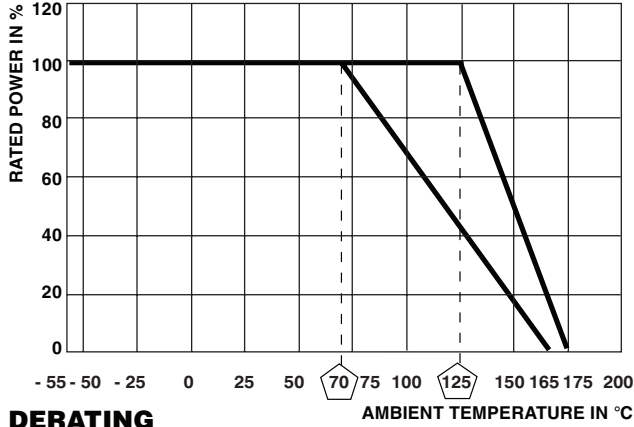
Notes:

- ⁽¹⁾ 1.08 ± 0.125 [27.43 ± 3.18] if tape and reel
- ⁽²⁾ Available with 0.032" with [0.813 mm] lead
- ⁽³⁾ 0.290" [7.37 mm] for ± 0.25 % and ± 0.1 % resistance tolerances and values > 1 MΩ
- ⁽⁴⁾ 0.260" ± 0.020" [6.60 mm ± 0.508 mm] for values > 5 MΩ

TECHNICAL SPECIFICATIONS								
PARAMETER	UNIT	CMF50	CMF55	CMF07	CMF60	CMF20	CMF65	CMF70
Maximum Working Voltage	V _≡	≤ 200	≤ 250	≤ 250	≤ 500	≤ 500	≤ 500	≤ 500
Insulation Voltage (1 Min)	V _{eff}	> 500						
Voltage Coefficient (Max.)	ppm/V	± 5 (measured between 10 % and full rated voltage)						
Dielectric Strength	V _{AC}	450	450	450	750	750	900	900
Insulation Resistance	Ω	≥ 10 ¹¹						
Operating Temperature Range	°C	- 55 to + 175						
Terminal Strength (Pull Test)	lb	2	2	5	2	5	2	5
Noise	dB	0.10 μV/V over a decade of frequency, with low and intermediate resistance values typically below 0.5 μV/V						
Weight (Max.)	g	0.12	0.20	0.20	0.50	0.60	1.00	1.10

TEMPERATURE COEFFICIENT CODES		
GLOBAL TC CODE	HISTORICAL TC CODE	TEMPERATURE COEFFICIENT
E	T-9	25 ppm/°C
H	T-2	50 ppm/°C
K	T-1	100 ppm/°C
L	T-0	150 ppm/°C
N	T-00	200 ppm/°C

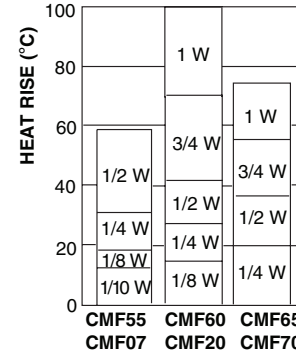
CMF resistors have an operating temperature range of - 55 °C to + 175 °C. They must be derated at high ambient temperatures according to the derating curve.



DERATING

The increase in resistor surface temperature due to the rated load is shown below.

Resistor surface temperature = heat rise plus ambient temperature.



HEAT RISE

MATERIAL SPECIFICATIONS			
Element:	Vacuum-deposited nickel-chrome alloy	Coating:	Flame retardant epoxy, formulated for superior moisture protection
Core:	Fire-cleaned high purity ceramic	Solderability:	Continuous satisfactory coverage when tested in accordance with MIL-R-10509

SPECIAL MODIFICATIONS

1. Terminals may be supplied in any commercial material with several type finishes.
2. Special pre-conditioning (power aging, temperature cycling, etc.) to customer specifications.
3. Non-helixed resistors can be supplied for critical high frequency applications.
4. Fusible, flameproof versions available.

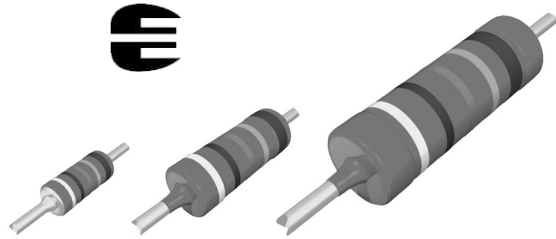
MARKING

- Value
 - Decade and Tolerance
 - Date code
- (Alternate parts may be MIL marked)



PERFORMANCE						
MODEL	POWER RATING					
	AT + 70 °C			AT + 125 °C		
CMF50	1/10 W	1/8 W	1/4 W	1/20 W	1/10 W	1/8 W
CMF55	1/8 W	1/4 W	1/2 W	1/10 W	1/8 W	1/4 W
CMF60	1/4 W	1/2 W	3/4 W and 1 W	1/8 W	1/4 W	1/2 W
CMF65	1/2 W	3/4 W	1 W	1/4 W	1/2 W	3/4 W
CMF70	1/2 W	3/4 W	1 W	1/4 W	1/2 W	3/4 W
CMF07	-	1/4 W	-	-	-	-
CMF20	-	1/2 W	1 W	-	-	-
TEST (Test methods - MIL-STD-202)	MAXIMUM ΔR (Typical Test Lots)					
Short Time Overload	-	$\pm 0.05\%$	-	-	$\pm 0.05\%$	-
Low Temperature Operation	-	$\pm 0.05\%$	-	-	$\pm 0.05\%$	-
Moisture Resistance	-	$\pm 0.05\%$	-	-	$\pm 0.05\%$	-
Shock	-	$\pm 0.01\%$	-	-	$\pm 0.01\%$	-
Vibration	-	$\pm 0.004\%$	-	-	$\pm 0.04\%$	-
Temperature Cycling	-	$\pm 0.15\%$	-	-	$\pm 0.15\%$	-
Load Life	$\pm 0.15\%$	$\pm 0.5\%$	$\pm 1.0\%$	$\pm 0.15\%$	$\pm 0.5\%$	$\pm 1.0\%$
Dielectric Withstanding Voltage	-	$\pm 0.01\%$	-	-	$\pm 0.01\%$	-
Effect of Solder	-	$\pm 0.03\%$	-	-	$\pm 0.03\%$	-

Professional Leaded Resistors



DESCRIPTION

MBA/SMA 0204, MBB/SMA 0207 and MBE/SMA 0414 professional leaded thin film resistors are the general purpose resistor for all fields of professional electronics where reliability and stability is of major concern. Typical applications include industrial, telecommunication and medical equipment.

FEATURES

- Approved according to CECC 40101-806
- Advanced thin film technology
- Power dissipation rating up to 1 W
- Excellent overall stability: class 0.25
- Wide professional range: 0.22 Ω to 22 MΩ
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- Industrial
- Telecommunication
- Medical equipment

METRIC SIZE

DIN:	0204	0207	0414
CECC:	A	B	D

TECHNICAL SPECIFICATIONS

DESCRIPTION	MBA/SMA 0204		MBB/SMA 0207		MBE/SMA 0414	
CECC Size	A		B		D	
Resistance Range	0.22 Ω to 10 MΩ		0.22 Ω to 22 MΩ		0.22 Ω to 22 MΩ	
Resistance Tolerance	± 5 %; ± 1 %; ± 0.5 %					
Temperature Coefficient	± 50 ppm/K; ± 25 ppm/K					
Operation Mode	long term	standard	long term	standard	long term	standard
Climatic Category (LCT/UCT/Days)	55/125/56	55/155/56	55/125/56	55/155/56	55/125/56	55/155/56
Rated Dissipation, P_{70}	0.25 W	0.4 W	0.4 W	0.6 W	0.65 W	1.0 W
Operating Voltage, U_{max} AC/DC	200 V		350 V		500 V	
Film Temperature	125 °C	155 °C	125 °C	155 °C	125 °C	155 °C
Max. Resistance Change at P_{70} for Resistance Range, $\Delta R/R$ max., After:	1 Ω to 332 kΩ		1 Ω to 1 MΩ		1 Ω to 2.4 MΩ	
1000 h	≤ 0.25 %	≤ 0.5 %	≤ 0.25 %	≤ 0.5 %	≤ 0.2 %	≤ 0.4 %
8000 h	≤ 0.5 %	≤ 1.0 %	≤ 0.5 %	≤ 1.0 %	≤ 0.4 %	≤ 0.8 %
225 000 h	≤ 1.5 %	-	≤ 1.5 %	-	≤ 1.2 %	-
Specified Lifetime	225 000 h	8000 h	225 000 h	8000 h	225 000 h	8000 h
Permissible Voltage Against Ambient (Insulation):						
1 Min; U_{ins}	300 V		500 V		800 V	
Continuous	75 V		75 V		75 V	
Failure Rate	≤ 0.7 x 10 ⁻⁹ /h		≤ 0.3 x 10 ⁻⁹ /h		≤ 0.1 x 10 ⁻⁹ /h	

Note:

MB_ series has been merged with the related SMA series to form one series "MB_/SMA_".



MBA/SMA 0204, MBB/SMA 0207, MBE/SMA 0414 - Professional

Professional Leaded Resistors

Vishay Beyschlag

PART NUMBER AND PRODUCT DESCRIPTION																	
PART NUMBER: MBB02070C1001FCT00																	
M	B	B	0	2	0	7	0	C	1	0	0	1	F	C	T	0	0
MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE			TOLERANCE	PACKAGING ⁽¹⁾	SPECIAL									
MBA0204 = MBA/SMA 0204 MBB0207 = MBB/SMA 0207 MBE0414 = MBE/SMA 0414	0 = Neutral N = RB Radial 5 mm S = UB Radial 2.5 mm	D = ± 25 ppm/K C = ± 50 ppm/K Z = Jumper	3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 2 = *10 ² 8 = *10 ⁻² 3 = *10 ³ 9 = *10 ⁻¹ 4 = *10 ⁴ 0 = *10 ⁰ 5 = *10 ⁵ 1 = *10 ¹ 6 = *10 ⁶ 0000 = Jumper			D = ± 0.5 % F = ± 1 % J = ± 5 % Z = Jumper	CT C1 RP R1 R2 R4 N4	00 = Standard									
PRODUCT DESCRIPTION: MBB/SMA 0207-50 1% CT 1K0																	
MBB/SMA 0207	-	50	1%	CT	1K0												
MODEL/SIZE		TCR	TOLERANCE	PACKAGING ⁽¹⁾	RESISTANCE												
MBA/SMA 0204 MBB/SMA 0207 MBE/SMA 0414		± 25 ppm/K ± 50 ppm/K	± 0.5 % ± 1.0 % ± 5.0 %	CT C1 RP R1 R2 R4 N4	1K0 = 1 kΩ 51R1 = 51.1 Ω												

Notes:

⁽¹⁾Please refer to table PACKAGING for complete information.

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products.

PACKAGING				
MODEL	REEL		BOX	
	PIECES	CODE	PIECES	CODE
MBA/SMA 0204	1000	R1	1000	C1
	5000	RP	5000	CT
MBB/SMA 0207	1000	R1	1000	C1
	4000	R4 (for RB, UB)	4000	N4 (for RB, UB)
	5000	RP	5000	CT
MBE/SMA 0414	2500	R2	1000	C1

12NC CODE FOR HISTORICAL CODING REFERENCE OF MBA 0204/MBB 0207/MBE 0414							
DESCRIPTION			ORDERING CODE 2312				
			AMMOPACK		REEL		
TYPE	TCR	TOL.	C1 1000 units	CT 5000 units	R1 1000 units	R2 2500 units	RP 5000 units
MBA 0204	± 50 ppm/K	± 5 %	900 3....	905 3....	700 3....	-	805 3....
		± 1 %	900 1....	905 1....	700 1....	-	805 1....
		± 0.5 %	900 5....	905 5....	700 5....	-	805 5....
	± 25 ppm/K	± 1 %	901 1....	906 1....	701 1....	-	806 1....
		± 0.5 %	901 5....	906 5....	701 5....	-	806 5....
jumper	-	900 90001	905 90001	700 90001	-	805 90001	
MBB 0207	± 50 ppm/K	± 5 %	910 3....	915 3....	710 3....	-	815 3....
		± 1 %	910 1....	915 1....	710 1....	-	815 1....
		± 0.5 %	910 5....	915 5....	710 5....	-	815 5....
	± 25 ppm/K	± 1 %	911 1....	916 1....	711 1....	-	816 1....
		± 0.5 %	911 5....	916 5....	711 5....	-	816 5....
jumper	-	910 90001	915 90001	710 90001	-	815 90001	
MBE 0414	± 50 ppm/K	± 5 %	920 3....	-	-	825 3....	-
		± 1 %	920 1....	-	-	825 1....	-
		± 0.5 %	920 5....	-	-	825 5....	-
	± 25 ppm/K	± 1 %	921 1....	-	-	826 1....	-
± 0.5 %		921 5....	-	-	826 5....	-	



12NC INFORMATION

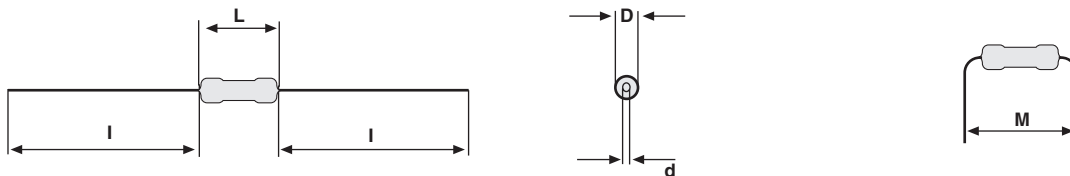
Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
0.1 Ω to 0.999 Ω	7
1 Ω to 9.99 Ω	8
10 Ω to 99.9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9.99 kΩ	2
10 kΩ to 99.9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9.99 MΩ	5
10 MΩ to 99.9 MΩ	6

12NC Example (for Historical Coding reference of MBA 0204/MBB 0207/MBE 0414)

The 12NC code of a MBA 0204 resistor, value 47.5 kΩ and TCR 50 with ± 1 % tolerance, supplied on bandolier in a box of 5000 units is: 2312 905 14753.

DIMENSIONS



DIMENSIONS - leaded resistor types, mass and relevant physical dimensions						
TYPE	D _{max.} (mm)	L _{max.} (mm)	d _{nom.} (mm)	l _{min.} (mm)	M _{min.} (mm)	MASS (mg)
MBA/SMA 0204	1.6	3.6	0.5	29.0	5.0	125
MBB/SMA 0207	2.5	6.3	0.6	28.0	10.0 ⁽¹⁾	220
MBE/SMA 0414	4.0	11.9	0.8	31.0	15.0	700

Note:

⁽¹⁾ For 7.5 ≤ M < 10.0 mm, use version MBB/SMA 0207 ... L0 without lacquer on the leads.

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
DESCRIPTION		RESISTANCE VALUE ⁽²⁾		
TCR	TOLERANCE	MBA/SMA 0204	MBB/SMA 0207	MBE/SMA 0414
± 50 ppm/K	± 5 %	0.22 Ω to 0.91 Ω	0.22 Ω to 0.91 Ω 11 MΩ to 22 MΩ	0.22 Ω to 0.91 Ω
	± 2%	-	0.22 Ω to 0.91 Ω	-
	± 1 %	1 Ω to 10 MΩ	1 Ω to 10 MΩ	1 Ω to 22 MΩ
	± 0.5 %	10 Ω to 475 kΩ	10 Ω to 1 MΩ	10 Ω to 2.4 MΩ
± 25 ppm/K	± 1 %	10 Ω to 475 kΩ	10 Ω to 1 MΩ	10 Ω to 2.4 MΩ
	± 0.5 %	10 Ω to 475 kΩ	10 Ω to 1 MΩ	10 Ω to 2.4 MΩ
Jumper	-	≤ 10 mΩ; I _{max.} = 3.0 A	≤ 10 mΩ, I _{max.} = 5.0 A	-

Notes:

⁽²⁾ Resistance value to be selected from E24 series for ± 5 %, ± 2 % tolerance, from E24/E96 series for ± 1 % tolerance and from E24/E192 for ± 0.5 % tolerance.

- Resistance ranges printed in bold are preferred TCR/tolerance combinations with optimized availability



DESCRIPTION

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 (85 % Al₂O₃) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the metallized rods. A special laser is used to achieve the target value by smoothly cutting a helical groove in the resistive layer without damaging the ceramics. Connecting wires of electrolytic copper plated with 100 % pure tin are welded to the termination caps. The resistor elements are covered by a light blue protective coating designed for electrical, mechanical and climatic protection. Four or five colour code rings designate the resistance value and tolerance in accordance with **IEC 60062**.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are stuck directly on the adhesive tapes in accordance with **IEC 60286-1**.

ASSEMBLY

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. Excellent solderability is proven, even after extended storage. They are suitable for automatic soldering using wave or dipping. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system. The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. The immunity of the plating against tin whisker growth has been proven under extensive testing. All products comply with the CEFIC-EECA-EICTA list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

- 2000/53/EC End of Vehicle Life Directive (ELV)
- 2000/53/EC Annex II to End of Vehicle Life Directive (ELV II)
- 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electrical Equipment Directive (WEEE)

APPROVALS

The resistors are tested in accordance with **CECC 40101-806** which refers to **EN 60115-1** and **EN 140100**. Approval of conformity is indicated by the CECC logo on the package label.

Vishay BEYSCHLAG has achieved “**Approval of Manufacturer**” in accordance with **EN 100114-1**.

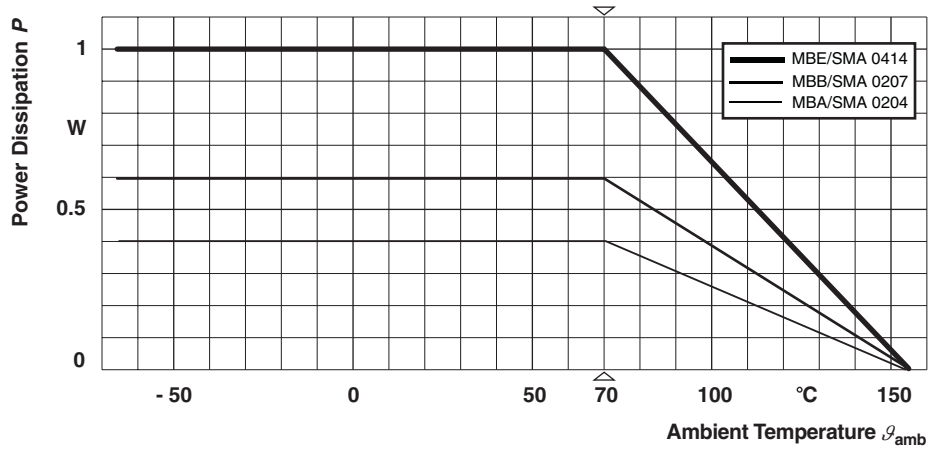
SPECIALS

This product family of leaded thin film resistors for professional applications is complemented by **Zero Ohm Jumpers** and **Isolators**.

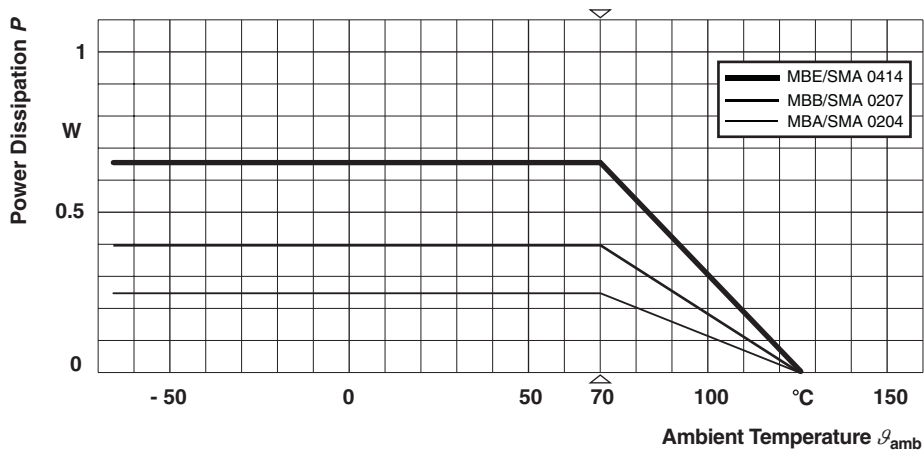
On request, resistors are available with established reliability in accordance with **CECC 40101-806 Version E**. Please refer to the special data sheet for information on failure rate level, available resistance ranges and ordering codes.



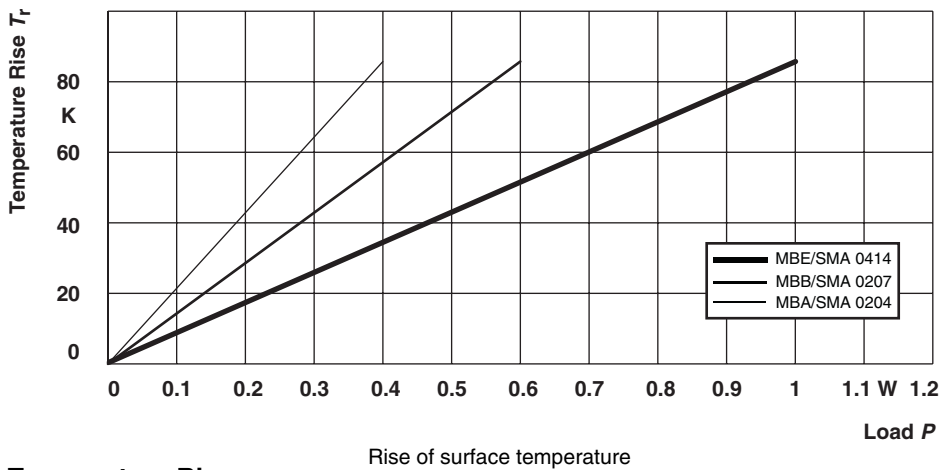
FUNCTIONAL PERFORMANCE



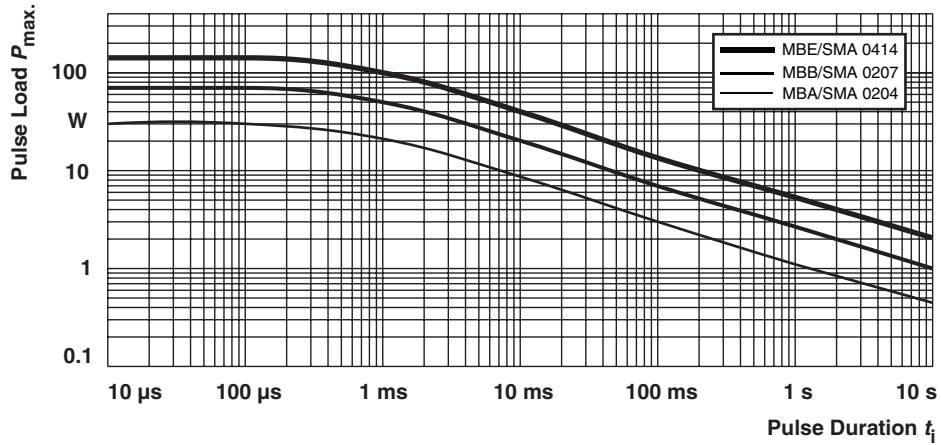
Derating - Standard Operation



Derating Long Term Operation

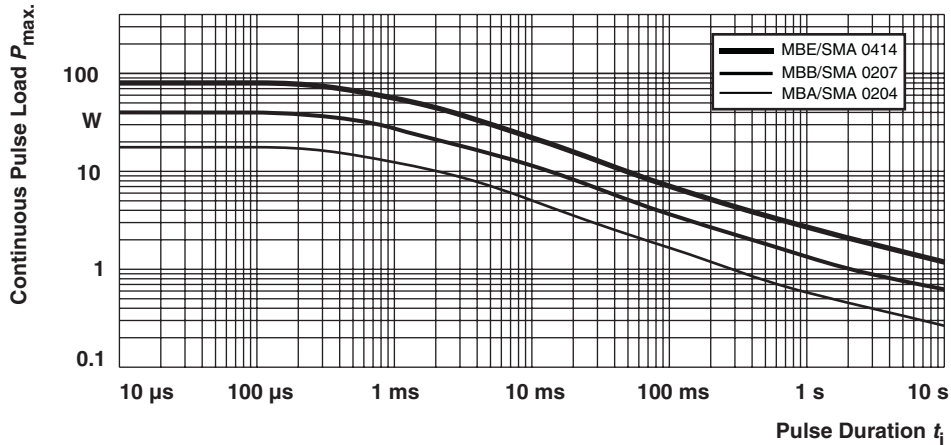


Temperature Rise



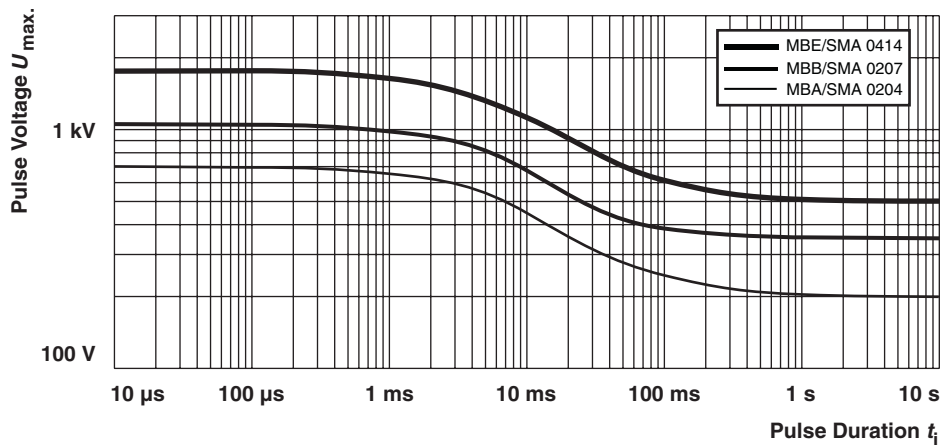
Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation.

Single Pulse



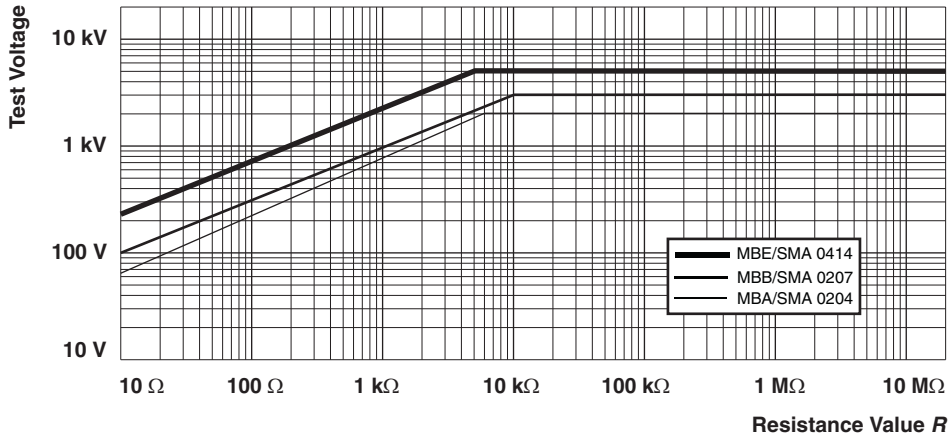
Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Continuous Pulse



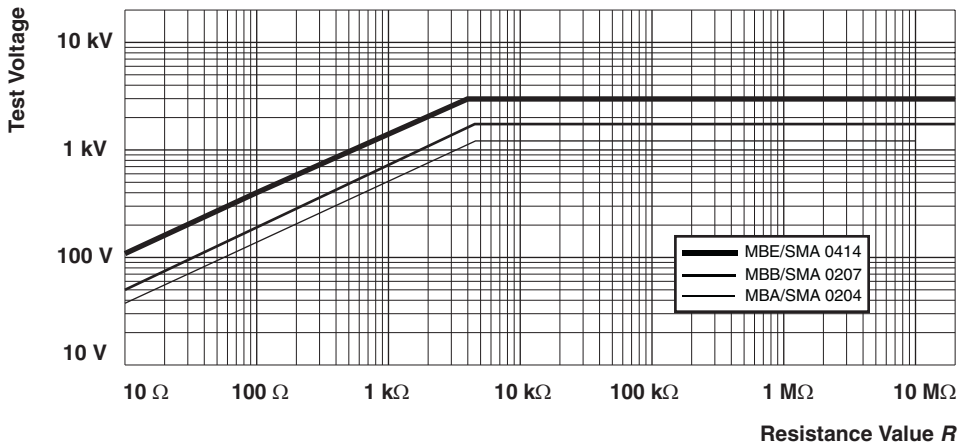
Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Pulse Voltage



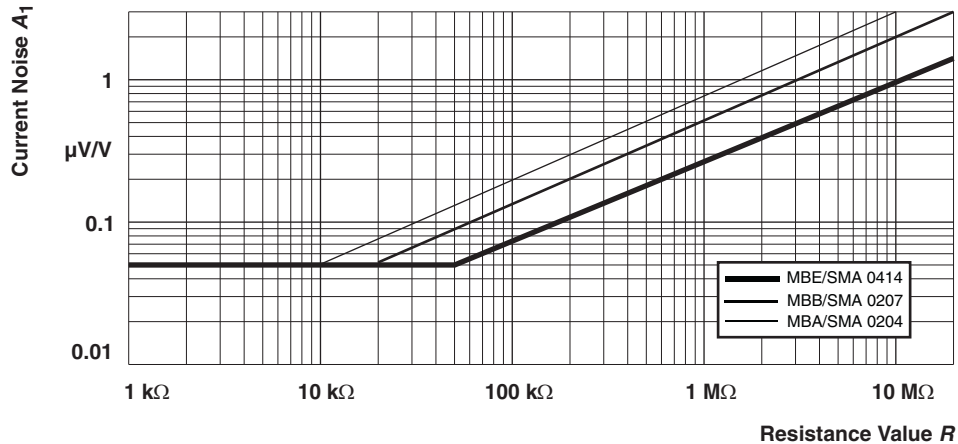
Pulse load rating in accordance with IEC 60115-1, 4.27; 1.2 μs/50 μs; 5 pulses at 12 s intervals; for permissible resistance change 0.5 %.

1.2/50 Pulse



Pulse load rating in accordance with IEC 60115-1, 4.27; 10 μs/700 μs; 10 pulses at 1 minute intervals; for permissible resistance change 0.5 %.

10/700 Pulse



Current noise - A₁ In Accordance With IEC 60195



TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the following specifications:

EN 140000/IEC 60115-1, Generic specification (includes tests)

EN 140100/IEC 60115-2, Sectional specification (includes schedule for qualification approval)

CECC 40101-806, Detail specification (includes schedule for conformance inspection)

Most of the components are approved in accordance with the European CECC-system, where applicable. The Test and Requirements table contains only the most important tests. For the full test schedule refer to the documents listed above. The testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5202.

The tests are carried out in accordance with IEC 60068 and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3. Climatic category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days) is valid.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 45 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

For testing the components are mounted on a test board in accordance with IEC 60115-1, 4.31 unless otherwise specified.

In Test Procedures and Requirements table, only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2; a short description of the test procedure is also given.

TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR max.)		
				STABILITY CLASS 0.5	STABILITY CLASS 1	STABILITY CLASS 2
			stability for product types:			
			MBA/SMA 0204	1 Ω to 332 k Ω	0.22 Ω to < 1 Ω	> 332 k Ω
			MBB/SMA 0207	1 Ω to 1 M Ω	0.22 Ω to < 1 Ω	> 1 M Ω
			MBE/SMA 0414	1 Ω to 2.4 M Ω	0.22 Ω to < 1 Ω	> 2.4 M Ω
4.5	-	resistance		$\pm 5 \%$; $\pm 1 \%$; $\pm 0.5 \%$		
4.8.4.2	-	temperature coefficient	at 20/LCT/20 °C and 20/UCT/20 °C	± 50 ppm/K; ± 25 ppm/K		

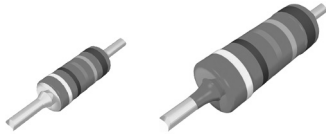


TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR max.)		
			stability for product types:	STABILITY CLASS 0.5	STABILITY CLASS 1	STABILITY CLASS 2
			MBA/SMA 0204	1 Ω to 332 k Ω	0.22 Ω to < 1 Ω	> 332 k Ω
			MBB/SMA 0207	1 Ω to 1 M Ω	0.22 Ω to < 1 Ω	> 1 M Ω
			MBE/SMA 0414	1 Ω to 2.4 M Ω	0.22 Ω to < 1 Ω	> 2.4 M Ω
4.25.1	-	endurance at 70 °C: standard operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h ON; 0.5 h OFF			
			70 °C; 1000 h	$\pm (0.5 \% R + 0.05 \Omega)$	$\pm (0.5 \% R + 0.05 \Omega)$	$\pm 0.5 \% R$
			70 °C; 8000 h	$\pm (1 \% R + 0.05 \Omega)$	$\pm (1 \% R + 0.05 \Omega)$	$\pm 1 \% R$
	-	endurance at 70 °C: long term operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h ON; 0.5 h OFF			
			70 °C; 1000 h	$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (0.25 \% R + 0.05 \Omega)$	$\pm 0.25 \% R$
			70 °C; 8000 h	$\pm (0.5 \% R + 0.05 \Omega)$	$\pm (0.5 \% R + 0.05 \Omega)$	$\pm 0.5 \% R$
4.25.3	-	endurance at upper category temperature	125 °C; 1000 h	$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (0.5 \% R + 0.05 \Omega)$	$\pm 1 \% R$
			155 °C; 1000 h	$\pm (0.5 \% R + 0.05 \Omega)$	$\pm (1 \% R + 0.05 \Omega)$	$\pm 2 \% R$
4.24	78 (Cab)	damp heat, steady state	(40 \pm 2) °C; 56 days; (93 \pm 3) % RH	$\pm (0.5 \% R + 0.05 \Omega)$	$\pm (1 \% R + 0.05 \Omega)$	$\pm 2 \% R$
4.23		climatic sequence:				
4.23.2	2 (Ba)	dry heat	155 °C; 16 h			
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; 90 % to 100 % RH; 1 cycle			
4.23.4	1 (Aa)	cold	- 55 °C; 2 h			
4.23.5	13 (M)	low air pressure	8.5 kPa; 2 h; 15 °C to 35 °C			
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 % to 100 % RH; 5 cycles	$\pm (0.5 \% R + 0.05 \Omega)$ no visible damage	$\pm (1 \% R + 0.05 \Omega)$ no visible damage	$\pm 2 \% R$ no visible damage



TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR max.)		
			stability for product types:	STABILITY CLASS 0.5	STABILITY CLASS 1	STABILITY CLASS 2
			MBA/SMA 0204	1 Ω to 332 k Ω	0.22 Ω to < 1 Ω	> 332 k Ω
			MBB/SMA 0207	1 Ω to 1 M Ω	0.22 Ω to < 1 Ω	> 1 M Ω
			MBE/SMA 0414	1 Ω to 2.4 M Ω	0.22 Ω to < 1 Ω	> 2.4 M Ω
4.13	-	short time overload	room temperature; $U = 2.5 \times \sqrt{P_{70}} \times \bar{R}$ or $U = 2 \times U_{max}$; 5 s	$\pm (0.1 \% R + 0.01 \Omega)$ no visible damage	$\pm (0.25 \% R + 0.05 \Omega)$ no visible damage	$\pm 0.5 \% R$ no visible damage
4.19	14 (Na)	rapid change of temperature	30 min at LCT and 30 min at UCT; 5 cycles	$\pm (0.1 \% R + 0.01 \Omega)$ no visible damage	$\pm (0.25 \% R + 0.05 \Omega)$ no visible damage	$\pm 0.5 \% R$ no visible damage
4.29	45 (XA)	component solvent resistance	isopropyl alcohol + 23 $^{\circ}\text{C}$; toothbrush method	marking legible; no visible damage		
4.18.2	20 (Tb)	resistance to soldering heat	unmounted components; (260 \pm 5) $^{\circ}\text{C}$; (10 \pm 1) s	$\pm (0.1 \% R + 0.01 \Omega)$ no visible damage	$\pm (0.25 \% R + 0.05 \Omega)$ no visible damage	$\pm 0.5 \% R$ no visible damage
4.17	20 (Ta)	solderability	+ 235 $^{\circ}\text{C}$; 2 s solder bath method	good tinning (> 95 % covered, no visible damage)		
4.22	6 (B4)	vibration	6 h; 10 Hz to 2000 Hz 1.5 mm or 196 m/s ²	$\pm (0.1 \% R + 0.01 \Omega)$	$\pm (0.25 \% R + 0.05 \Omega)$	$\pm 0.5 \% R$
4.16	21 (Ua ₁) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	$\pm (0.1 \% R + 0.01 \Omega)$	$\pm (0.25 \% R + 0.05 \Omega)$	$\pm 0.5 \% R$
4.7	-	voltage proof	$U_{RMS} = U_{ins}$; 60 s	no flashover or breakdown		

Professional Leaded Resistors



DESCRIPTION

A homogeneous 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 coated with lacquer which provides electrical, mechanical, and climatic protection. Four or five colour code rings designate the resistance value and tolerance according to **IEC 60 062**. Suitable replacements for MRS16 and MRS25 are MBA/SMA 0204 and MBB/SMA 0207 professional.

FEATURES

- Professional resistors in small outlines
- Low noise
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)

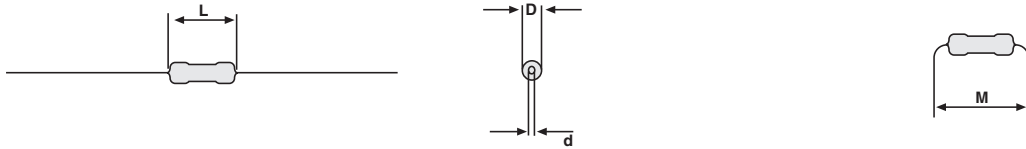


APPLICATIONS

- All general purpose applications

TECHNICAL SPECIFICATIONS		
DESCRIPTION	VALUE	
	MRS16	MRS25
Resistance Range	4.99 Ω to 1 MΩ	1 Ω to 10 MΩ
Resistance Tolerance and Series	± 1 %; E24/E96 series	
Maximum Dissipation at T _{amb} = 70 °C	0.4 W	0.6 W
Thermal Resistance (R _{th})	170 K/W	150 K/W
Temperature Coefficient	± 50 ppm/K	
Maximum Permissible Voltage (DC or RMS)	200 V	350 V
Basic Specifications	IEC 60115-1 and 60115-2	
Climatic Category (IEC 60068)	55/155/56	
Max. Resistance Change for Resistance Range, ΔR max., After:		
Load:		
R ≤ 100 kΩ	± (0.5 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)
R > 100 kΩ	± (1 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)
Climatic Tests:		
R ≤ 100 kΩ	± (0.5 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)
R > 100 kΩ	± (1 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)
Soldering:		
R ≤ 100 kΩ	± (0.1 % R + 0.05 Ω)	± (0.1 % R + 0.05 Ω)
R > 100 kΩ	± (0.25 % R + 0.05 Ω)	± (0.1 % R + 0.05 Ω)
Short Time Overload	± (0.25 % R + 0.05 Ω)	± (0.25 % R + 0.05 Ω)

PACKAGING				
MODEL	REEL		BOX	
	PIECES/REEL	CODE	PIECES/BOX	CODE
MRS16	5000	RP	1000 5000	C1 CT
MRS25	5000	RP	1000 5000	C1 CT

DIMENSIONS


DIMENSIONS - leaded resistor types, mass and relevant physical dimensions					
TYPE	D _{max.} (mm)	L _{max.} (mm)	d _{nom.} (mm)	M _{min.} (mm)	MASS (mg)
MRS16	1.6	3.6	0.5	5.0	125
MRS25	2.5	6.3	0.6	10.0	220

12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 2322 15.
- The subsequent 2 digits indicate the resistor type and packaging; see the 12NC Ordering Code table.
- The remaining 4 digits indicate the resistance value:
 - The first 3 digits indicate the resistance value.
 - The last digit indicates the resistance decade in accordance with the 12NC Indicating Resistance Decade table.

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
1 Ω to 9.76 Ω	8
10 Ω to 97.6 Ω	9
100 Ω to 976 Ω	1
1 kΩ to 9.76 kΩ	2
10 kΩ to 97.6 kΩ	3
100 kΩ to 976 kΩ	4
1 MΩ to 9.76 MΩ	5
10 MΩ	6

12NC Example

The 12NC of a MRS16 resistor, value 750 Ω, on a bandolier of 1000 units in ammpack is: 2322 157 17501.

12NC - resistors type and packaging

TYPE	ORDERING CODE 2322 15.		
	BANDOLIER IN AMMPACK		BANDOLIER ON REEL
	1000 UNITS	5000 UNITS	5000 UNITS
MRS16	7 1....	7 2....	7 3....
MRS25	6 1....	6 2....	6 3....

PART NUMBER AND PRODUCT DESCRIPTION
PART NUMBER: MRS1600C5119FCT00

M	R	S	1	6	0	0	0	C	5	1	1	9	F	C	T	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MODEL/SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING ⁽¹⁾	SPECIAL
MRS1600 MRS2500	0 = Neutral	C = ± 50 ppm/K	3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 2 = *10 ² 8 = *10 ⁻² 3 = *10 ³ 9 = *10 ⁻¹ 4 = *10 ⁴ 0 = *10 ⁰ 5 = *10 ⁵ 1 = *10 ¹ 6 = *10 ⁶	F = ± 1 %	RP CT C1	Up to 2 digits 00 = Standard
PRODUCT DESCRIPTION: MRS 16-50 1 % CT 51R1						
MRS16	50	1 %	CT	51R1		
MODEL/SIZE	TCR	TOLERANCE	PACKAGING ⁽¹⁾	RESISTANCE VALUE		
MRS16 MRS25	± 50 ppm/K	± 1 %	RP CT C1	51R1 = 51.1 Ω 1K = 1 kΩ		

Notes:
⁽¹⁾ Please refer packaging table

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

Standard Metal Film Resistors



A homogeneous 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 leads of electrolytic copper are welded to the end-caps.

The resistors are coated with a colored lacquer (light-blue for type SFR16S; light-green for type SFR25 and red-brown for type SFR25H) which provides electrical, mechanical and climatic protection. The encapsulation is resistant to all cleaning solvents, in accordance with "MIL-STD-202E, method 215", and "IEC 60068-2045".

FEATURES

- Low cost
- Low noise (max. 1.5 $\mu\text{V/V}$ for $R > 1 \text{ M}\Omega$)
- Small size (SFR16S-0204, SFR25/25H-0207)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- General purpose resistors

TECHNICAL SPECIFICATIONS			
DESCRIPTION	VALUE		
	SFR16S	SFR25	SFR25H
Resistance Range	$\pm 5 \%$; 1 Ω to 3 $\text{M}\Omega$ $\pm 1 \%$; 4.99 Ω to 3 $\text{M}\Omega$ jumper (0 Ω)	$\pm 5 \%$; 0.22 Ω to 10 $\text{M}\Omega$ $\pm 1 \%$; 1 Ω to 10 $\text{M}\Omega$ jumper (0 Ω)	
Resistance Tolerance	$\pm 1 \%$, E24/E96 series; $\pm 5 \%$, E24 series		
Temperature Coefficient: $R < 4.7 \Omega$ $4.7 \Omega \leq R \leq 100 \text{ k}\Omega$ $100 \text{ k}\Omega < R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	$\leq \pm 250 \times 10^{-6}/\text{K}$ $\leq \pm 100 \times 10^{-6}/\text{K}$ $\leq \pm 250 \times 10^{-6}/\text{K}$ $\leq \pm 250 \times 10^{-6}/\text{K}$	$\leq \pm 100 \times 10^{-6}/\text{K}$ $\leq \pm 100 \times 10^{-6}/\text{K}$ $\leq \pm 100 \times 10^{-6}/\text{K}$ $\leq \pm 250 \times 10^{-6}/\text{K}$	$\leq \pm 100 \times 10^{-6}/\text{K}$ $\leq \pm 100 \times 10^{-6}/\text{K}$ $\leq \pm 100 \times 10^{-6}/\text{K}$ $\leq \pm 250 \times 10^{-6}/\text{K}$
Absolute Maximum Dissipation at $T_{\text{amb}} = 70 \text{ }^\circ\text{C}$	0.5 W	0.4 W	0.5 W
Thermal Resistance, R_{th}	170 K/W	200 K/W	150 K/W
Maximum Permissible Voltage	200 V	250 V	350 V
Noise: $R < 68 \text{ k}\Omega$ $68 \text{ k}\Omega \leq R \leq 100 \text{ k}\Omega$ $100 \text{ k}\Omega \leq R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	max. 0.1 $\mu\text{V/V}$ max. 0.5 $\mu\text{V/V}$ max. 1.5 $\mu\text{V/V}$ max. 1.5 $\mu\text{V/V}$	max. 0.1 $\mu\text{V/V}$ max. 0.1 $\mu\text{V/V}$ max. 0.1 $\mu\text{V/V}$ max. 1.5 $\mu\text{V/V}$	max. 0.1 $\mu\text{V/V}$ max. 0.1 $\mu\text{V/V}$ max. 0.1 $\mu\text{V/V}$ max. 1.5 $\mu\text{V/V}$
Basic Specifications	IEC 60115-1 and 60115-2		
Climatic Category (IEC 60068)	55/155/56		
Stability, ΔR max., After: Load: R range Climatic Tests: $R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	$\pm (2 \% R + 0.05 \Omega)$ $\pm (1 \% R + 0.05 \Omega)$ $\pm (1 \% R + 0.05 \Omega)$	$\pm (2 \% R + 0.05 \Omega)$ $\pm (1 \% R + 0.05 \Omega)$ $\pm (1 \% R + 0.05 \Omega)$	$\pm (2 \% R + 0.05 \Omega)$ $\pm (1 \% R + 0.05 \Omega)$ $\pm (2 \% R + 0.1 \Omega)$
Soldering	$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (0.25 \% R + 0.05 \Omega)$
Short Time Overload	$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (1 \% R + 0.05 \Omega)$

Note:

- R value is measured with probe distance of $24 \pm 1 \text{ mm}$ using 4-terminal method



12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 23.
- The subsequent 6 digits for 1 % or 7 digits for 5 % indicate the resistor type and packaging.
- The remaining digits indicate the resistance value:
 - The first 3 digits for 1 % or 2 digits for 5 % indicate the resistance value.
 - The last digit indicates the resistance decade.

Last Digit of 12NC for ± 5 % Tolerance

RESISTANCE DECADE	LAST DIGIT
0.10 to 0.91 Ω	7
1 to 9.1 Ω	8
10 to 91 Ω	9
100 to 910 Ω	1
1 to 9.1 kΩ	2
10 to 91 kΩ	3
100 to 910 kΩ	4
1 to 9.1 MΩ	5
≥ 10 MΩ	6

Last Digit of 12NC for ± 1 % Tolerance

RESISTANCE DECADE	LAST DIGIT
1 to 9.76 Ω	8
10 to 97.6 Ω	9
100 to 976 Ω	1
1 to 9.76 kΩ	2
10 to 97.6 kΩ	3
100 to 976 kΩ	4
1 to 9.76 MΩ	5
≥ 10 MΩ	6

12NC Example

The 12NC of a SFR25 resistor, value 5600 Ω ± 5 %, taped on a bandolier of 5000 units in ammpack is: 2322 181 43562.

12NC - resistor type and packaging					
TYPE	TOL.	ORDERING CODE 23..			
		BANDOLIER IN AMMOPACK			BANDOLIER ON REEL
		RADIAL TAPED	STRAIGHT LEADS		STRAIGHT LEADS
		4000 units	1000 units	5000 units	5000 units
SFR16S	± 5 %	–	..22 187 73...	..22 187 53...	..06 187 23...
	± 1 %	–	–	..06 187 3...	..06 187 1....
	jumper ⁽¹⁾	–	–	..06 187 90013	..22 187 90346
SFR25	± 5 %	..06 184 03...	..22 181 53...	..22 181 43...	..22 181 63...
	± 1 %	–	–	..22 188 2...	..06 181 8....
	jumper ⁽²⁾	–	..22 181 90018	..22 181 90019	..06 181 90011
SFR25H	± 5 %	–	..22 186 16...	..22 186 76...	..06 186 63...
	± 1 %	–	–	..22 186 3....	..06 186 8....

Notes:

(1) The jumper has a maximum resistance $R_{max.} = 30 \text{ m}\Omega$ at 3 A (SFR16S).

(2) The jumper has a maximum resistance $R_{max.} = 10 \text{ m}\Omega$ at 5 A (SFR25).

PART NUMBER AND PRODUCT DESCRIPTION						
PART NUMBER: SFR2500001001FA500						
S	F	R	2	5	0	0
0	0	0	0	1	0	0
1	0	0	1	F	A	5
0	0	0	0	0	0	0
MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING ⁽³⁾	SPECIAL
SFR16S0 SFR2500 SFR25H0	0 = Neutral Z = Value overflow (special)	0 = Standard Z = Jumper	3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 2 = *10 ² 8 = *10 ⁻² 3 = *10 ³ 9 = *10 ⁻¹ 4 = *10 ⁴ 0 = *10 ⁰ 5 = *10 ⁵ 1 = *10 ¹ Z = 0000	F = ± 1 % J = ± 5 % Z = Jumper	N4 A5 A1 R5	The 2 digits are used for all special parts. 00 = Standard
PRODUCT DESCRIPTION: SFR25 1 % A5 1K0						
SFR25	1 %	A5	1K0			
MODEL/SIZE	TOLERANCE	PACKAGING ⁽³⁾	RESISTANCE VALUE			
SFR16S SFR25 SFR25H	± 1 % ± 5 %	N4 A5 A1 R5	47K = 47 kΩ 51R1 = 51.1 Ω			

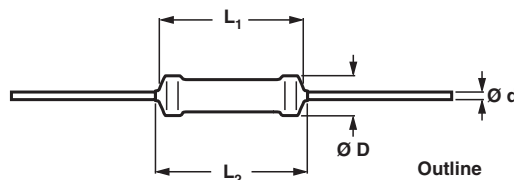
Notes:

(3) Please refer to table PACKAGING.

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products.

PACKAGING			
CODE	PIECES	DESCRIPTION	MODEL/SIZE
N4	4000	Bandolier in ammpack radial taped	SFR25
A5	5000	Bandolier in ammpack straight leads	SFR16S, SFR25, SFR25H
A1	1000	Bandolier in ammpack straight leads	SFR16S, SFR25, SFR25H
R5	5000	Bandolier on reel straight leads	SFR16S, SFR25, SFR25H

DIMENSIONS



DIMENSIONS - resistor types and relevant physical dimensions in millimeters				
TYPE	$\varnothing D_{max.}$	$L_1_{max.}$	$L_2_{max.}$	$\varnothing d$
SFR16S	1.9	3.5	4.1	0.45 ± 0.05
SFR25	2.5	6.5	7.5	0.58 ± 0.05
SFR25H	2.5	6.5	7.5	0.58 ± 0.05

MASS PER 100 UNITS	
TYPE	MASS (g)
SFR16S	10.2
SFR25	20.5
SFR25H	20.5

OUTLINES

The length of the body (L_1) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation ("IEC publication 60294").

MARKING

The nominal resistance and tolerance are marked on the resistor using four or five coloured bands in accordance with IEC publication 60062 "Color codes for fixed resistors".

FUNCTIONAL PERFORMANCE

PRODUCT CHARACTERIZATION

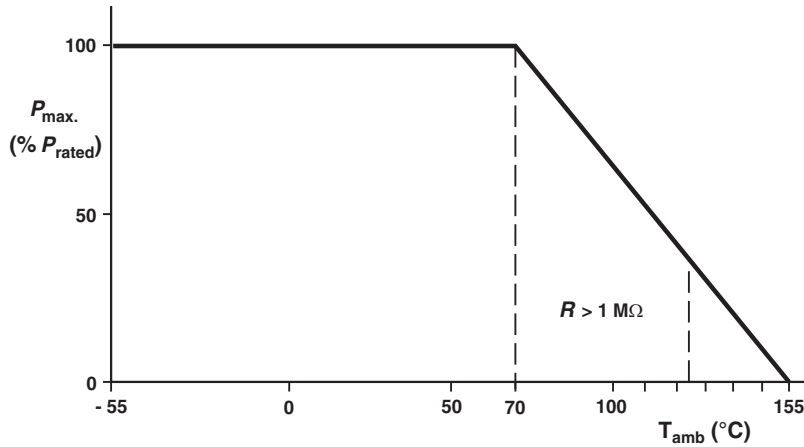
Standard values of nominal resistance are taken from the E96/E24 series for resistors with a tolerance of $\pm 1\%$ or $\pm 5\%$. The values of the E96/E24 series are in accordance with "IEC publication 60063".

LIMITING VALUES		
TYPE	LIMITING VOLTAGE ⁽¹⁾ (V)	LIMITING POWER (W)
SFR16S	200	0.5
SFR25	250	0.4
SFR25H	350	0.5

Note:

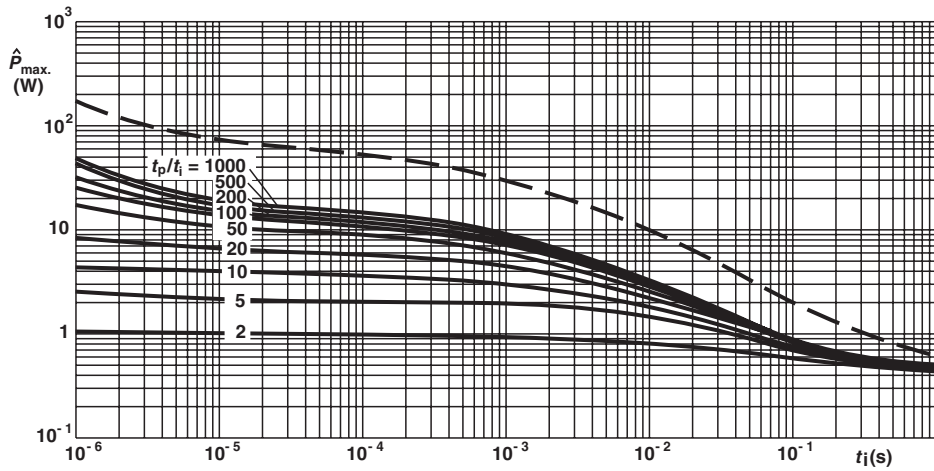
⁽¹⁾ The maximum voltage that may be continuously applied to the resistor element, see "IEC publication 60115-1". The maximum permissible hot-spot temperature is 155 °C.

The power that the resistor can dissipate depends on the operating temperature

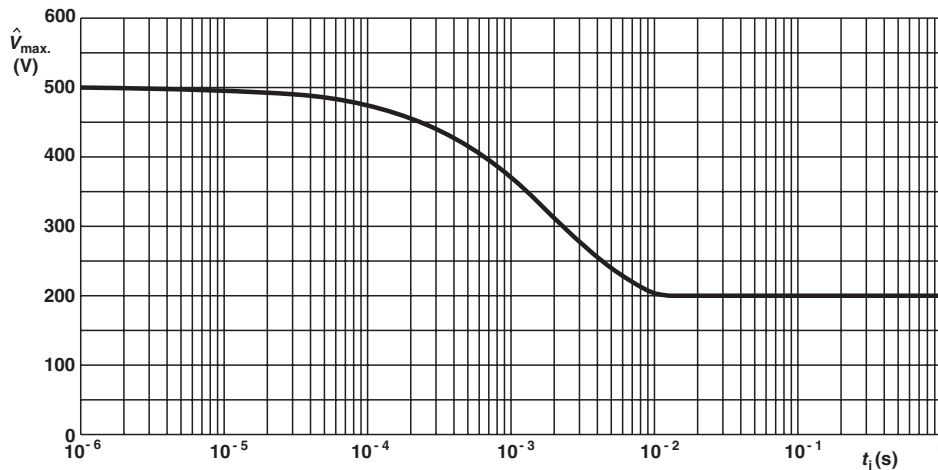


Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

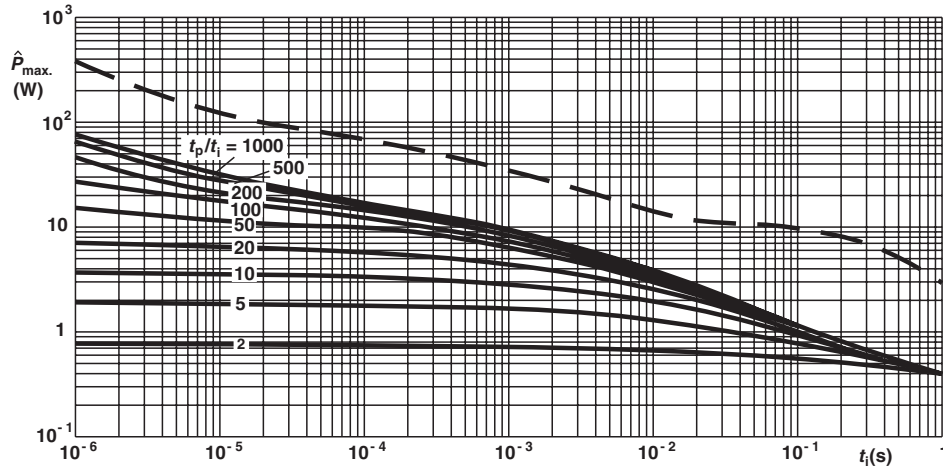
Derating



SFR16S Pulse on a regular basis; maximum permissible peak pulse power (\hat{P}_{max}) as a function of pulse duration (t_i)

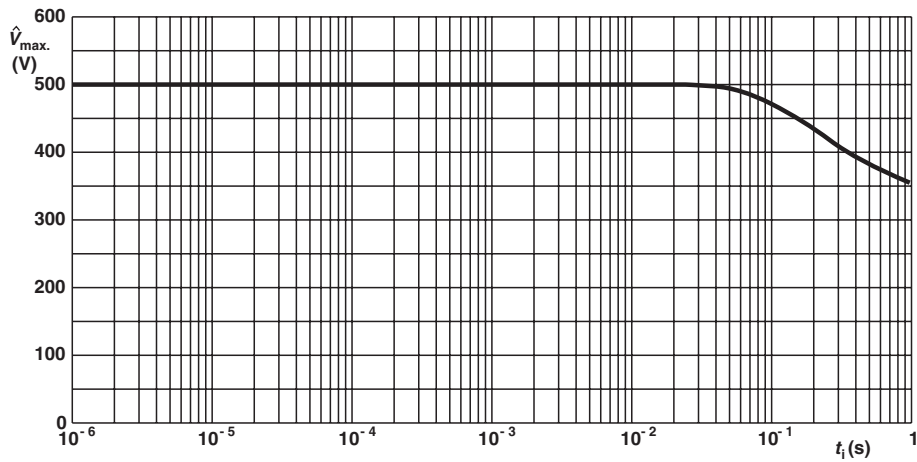


SFR16S Pulse on a regular basis; maximum permissible peak pulse voltage (\hat{V}_{max}) as a function of pulse duration (t_i)

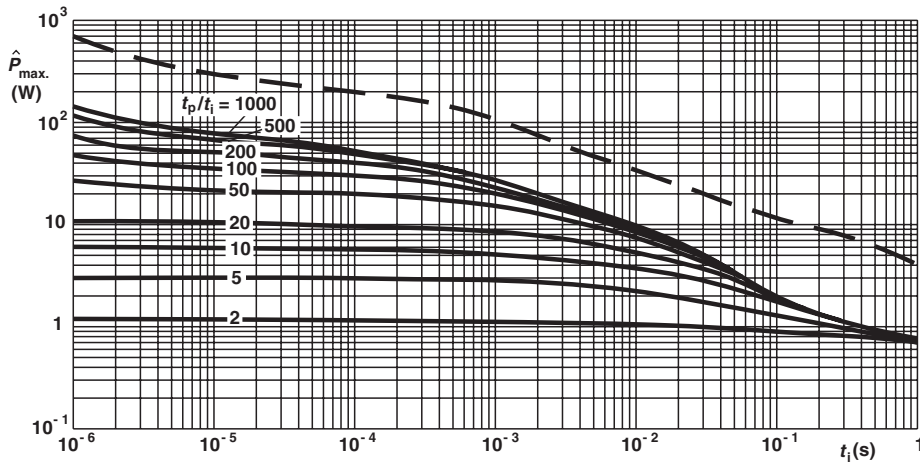


SFR25 Pulse on a regular basis; maximum permissible peak pulse power (\hat{P}_{max}) as a function of pulse duration (t_i)

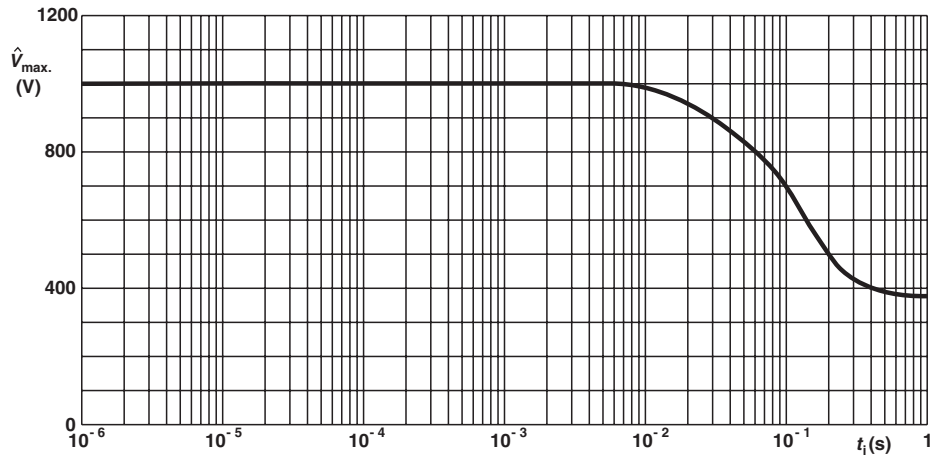
Pulse Loading Capabilities



SFR25 Pulse on a regular basis; maximum permissible peak pulse voltage (\hat{V}_{max}) as a function of pulse duration (t_i)

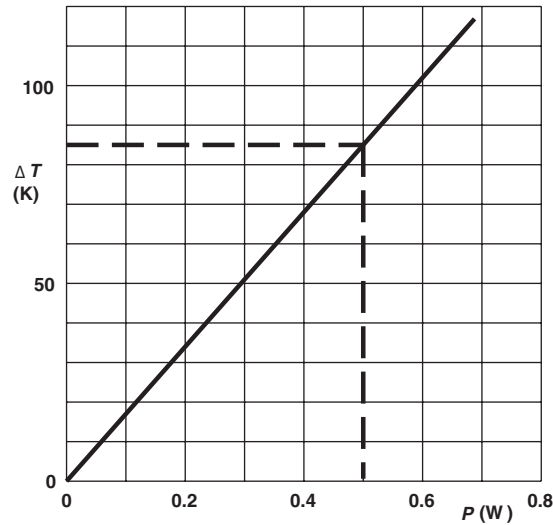


SFR25H Pulse on a regular basis; maximum permissible peak pulse power (\hat{P}_{max}) as a function of pulse duration (t_i)

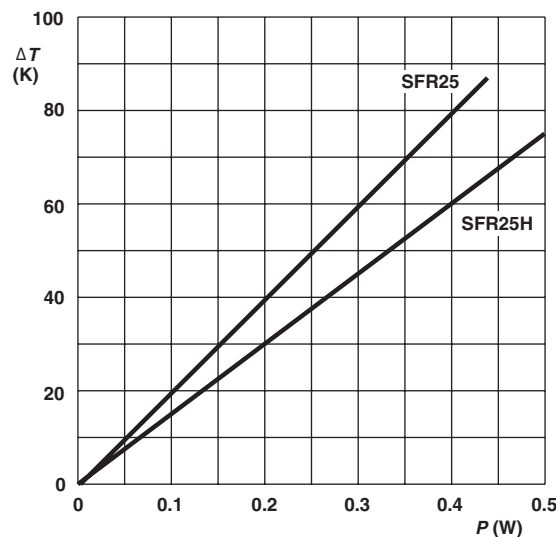


SFR25H Pulse on a regular basis; maximum permissible peak pulse voltage (\hat{V}_{max}) as a function of pulse duration (t_i)

Pulse Loading Capabilities



SFR16S Hot-spot temperature rise (ΔT) as a function of dissipated power



SFR25/SFR25H Hot-spot temperature rise (ΔT) as a function of dissipated power

Application Information

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-1", category 55/155/56 (rated temperature range - 55 °C to + 155 °C; damp heat, long term, 56 days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 60068-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and

under standard atmospheric conditions according to "IEC 60068-1", subclause 5.3.

In the Test Procedures and Requirements table the tests and requirements are listed with reference to the relevant clauses of "IEC publications 60115-1 and 60068-2"; a short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying.

TEST PROCEDURES AND REQUIREMENTS							
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					SFR16S	SFR25	SFR25H
4.16	21 (U)	robustness of terminations:			number of failures < 10 x 10 ⁻⁶		
4.16.2	21 (Ua1)	tensile all samples	Ø 0.45 mm, load 5 N; 10 s Ø 0.58 mm, load 10 N; 10 s				
4.16.3	21 (Ub)	bending half number of samples	Ø 0.45 mm, load 2.5 N; 4 x 90° Ø 0.58 mm, load 5 N; 4 x 90°				
4.16.4	21 (Uc)	torsion other half of samples	3 x 360° in opposite directions				
4.17	20 (Ta)	solderability	2 s; 235 °C; flux 600		good tinning; no damage		
4.18	20 (Tb)	resistance to soldering heat	3.5 seconds; 350 °C; solder bath method		ΔR max.: $\pm (0.25 \% R + 0.05 \Omega)$		
4.19	14 (Na)	rapid change of temperature	30 min at - 55 °C and 30 min at + 155 °C; 5 cycles		ΔR max.: $\pm (0.25 \% R + 0.05 \Omega)$		
4.20	29 (Eb)	bump	3 x 1500 bumps in 3 directions; 40 g		no damage ΔR max.: $\pm (0.25 \% R + 0.05 \Omega)$		
4.22	6 (Fc)	vibration	Frequency 10 Hz to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 h (3 x 2 h)		no damage ΔR max.: $\pm (0.25 \% R + 0.05 \Omega)$		
4.23		climatic sequence:			R_{ins} min.: 1000 M Ω		
4.23.2	2 (Ba)	dry heat	16 h; 155 °C				
4.23.3	30 (Db)	damp heat (accelerated) 1st cycle	24 h; 55 °C; 90 % to 100 % RH				
4.23.4	1 (Aa)	cold	2 h; - 55 °C				
4.23.5	13 (M)	low air pressure	2 h; 8.5 kPa; 15 °C to 35 °C				
4.23.6	30 (Db)	damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 % to 100 % RH	$R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$			
4.24.2	3 (Ca)	damp heat (steady state)	56 days; 40 °C; 90 % to 95 % RH; dissipation 0.01 Pn		R_{ins} min.: 1000 M Ω ΔR max.: $\pm (2 \% R + 0.05 \Omega)$		

TEST PROCEDURES AND REQUIREMENTS							
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					SFR16S	SFR25	SFR25H
4.25.1		endurance	1000 h at 70 °C; P _n or V _{max} .		ΔR max.: $\pm (2 \% R + 0.05 \Omega)$		
4.8.4		temperature coefficient	between - 55 °C and + 155 °C (TCR x 10 ⁻⁶ /K)	R < 4.7 Ω R ≤ 100 kΩ R ≤ 1 MΩ R > 1 MΩ	≤ ± 250 ≤ ± 100 ≤ ± 250 ≤ ± 250	≤ ± 100 ≤ ± 100 ≤ ± 100 ≤ ± 250	≤ ± 100 ≤ ± 100 ≤ ± 100 ≤ ± 250
4.7		voltage proof on insulation	U _{RMS} = 400 V (SFR16S) or U _{RMS} = 600 V (SFR25 and SFR25H); during 1 min; V-block method		no breakdown		
4.12		noise	"IEC publication 60195"	R < 68 kΩ R ≤ 100 kΩ R ≤ 1 MΩ R > 1 MΩ	max. 0.1 μV/V max. 0.5 μV/V max. 1.5 μV/V max. 1.5 μV/V	max. 0.1 μV/V max. 0.1 μV/V max. 0.1 μV/V max. 1.5 μV/V	max. 0.1 μV/V max. 0.1 μV/V max. 0.1 μV/V max. 1.5 μV/V
4.6.1.1		insulation resistance	U _{max} . DC = 500 V during 1 min; V-block method		R _{ins} min.: 1000 MΩ		
4.13		short time overload	Room temperature; P = 6.25 x P _n (SFR25) or 6.25 x 0.25 W (SFR16S); 5 s ON, 45 s OFF (V ≤ 2 x V _{max} .); 10 cycles		ΔR max.: $\pm (0.25 \% R + 0.05 \Omega)$		ΔR max.: $\pm (1 \% R + 0.05 \Omega)$
		intermittent overload in accordance with "JIS-C5202 5.8"	16 x 0.16 W; 1 s ON and 25 s OFF; 10 000 ± 200 cycles; V _{max} . = 600 V		ΔR max.: $\pm (0.75 \% R + 0.05 \Omega)$	-	-
see 2 nd amendment to "IEC 60115-1", Jan. '87		pulse load			see Pulse Loading Capabilities graphs		

Precision Hermetic Metal Film Resistors Commercial



FEATURES

- Hermetic glass enclosure is impervious to harmful environments
- Inert gas filled
- Low noise (- 40 dB)
- Low TCR (down to 15 ppm/°C)

GENERAL SPECIFICATIONS

Resistance Range: 10.0 Ω to 10.0 MΩ

Tolerance: ± 0.05 %, ± 0.1 %, ± 0.5 %, and ± 1.0 %

Temperature Characteristics:

± 15 ppm/°C to ± 50 ppm/°C

Power Ratings:

1/10, 1/8, 1/4, 1/2 and 1 W - 125 °C

1/8, 1/4, 1/2, 3/4, and 2 W - 70 °C

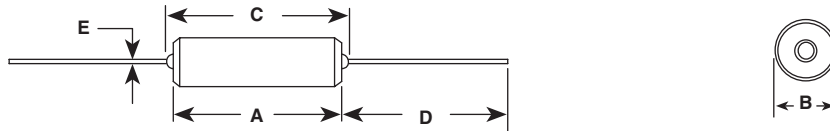
Power Derating: For ambient temperatures above 125 °C, see Power Derating Curve.

MECHANICAL SPECIFICATIONS

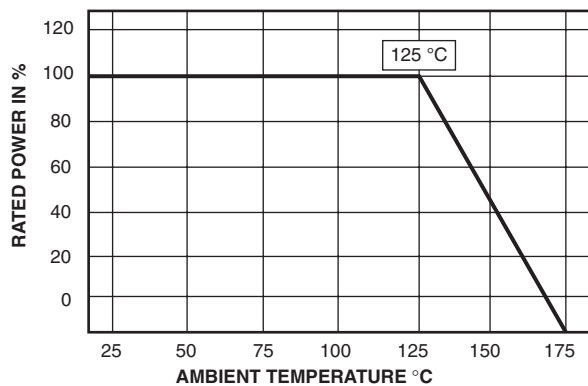
Termination: Vishay Angstrom GSR Resistors use gold-plated nickel leads, which are both solderable and weldable (hot solder dip is available as an option).

STANDARD ELECTRICAL SPECIFICATIONS					
MODEL	POWER RATING (W)		MAXIMUM WORKING VOLTAGE	RESISTANCE RANGE (Ω)	
	125 °C	70 °C		MIN.	MAX.
GSR55	0.10	0.125	200	10	2.5 M
GSR57	0.125	0.25	250	10	1 M
GSR60	0.125	0.25	250	10	3 M
GSR65	0.25	0.50	300	10	10 M
GSR70	0.50	0.75	350	10	10 M
GSR75	1.0	2.0	750	10	5 M

GLOBAL PART NUMBER INFORMATION																	
New Global Part Numbering: GSR55E49R900BMR (preferred part number format)																	
G	S	R	5	5	E	4	9	R	9	0	0	B	M	R			
GLOBAL MODEL <small>(see Standard Electrical Specifications table)</small>		TEMPERATURE COEFFICIENT X = 15 ppm E = 25 ppm H = 50 ppm		RESISTANCE VALUE R = Decimal K = Thousand M = Million 10R000 = 10 Ω 49R900 = 49.9 Ω 680K00 = 680 kΩ 1M0000 = 1.0 MΩ			TOLERANCE CODE A = ± 0.05 % B = ± 0.1 % D = ± 0.5 % F = ± 1.0 %			PACKAGING MR = Foil Bag (55, 57, 60, 65, 70) MS = Foil Bag (75 only) CS = Reel (55, 57, 60) CT = Reel (65, 70, 75) KA = Ammo (55, 57, 60) KC = Ammo (65, 70, 75)			SPECIAL Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable				
Historical Part Numbering: GSR55E49R9B (will continue to be accepted)																	
GSR55		E			49R9			B									
HISTORICAL MODEL		TEMPERATURE COEFFICIENT			RESISTANCE VALUE			TOLERANCE CODE									

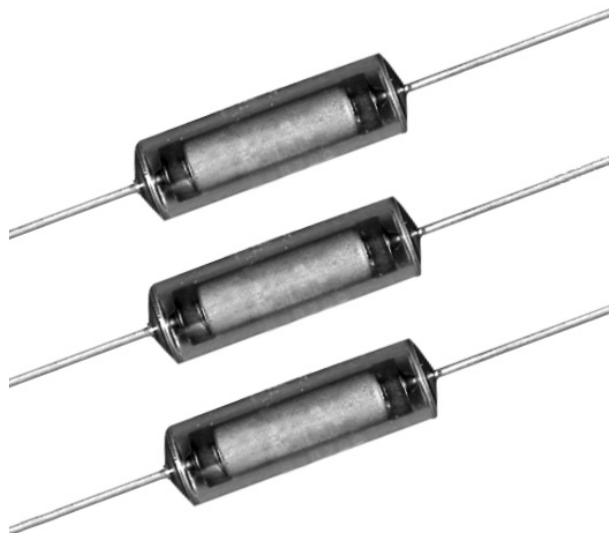
DIMENSIONS in inches [millimeters]


MODEL	A LENGTH	B DIAMETER	C CL TO CL (MAX.)	D LENGTH ± 0.125 [± 3.18]	E DIAMETER ± 0.002 [± 0.051]	D APPROX. WEIGHT (g)
GSR55	0.280 ± 0.020 [7.11 \pm 0.51]	0.110 ± 0.020 [2.79 \pm 0.51]	0.379 [9.63]	1.50 [38.10]	0.025 [0.635]	0.337
GSR57	0.310 ± 0.025 [7.87 \pm 0.64]	0.150 ± 0.020 [3.81 \pm 0.51]	0.467 [11.86]	1.50 [38.10]	0.025 [0.635]	0.405
GSR60	0.425 ± 0.030 [10.80 \pm 0.76]	0.150 ± 0.020 [3.81 \pm 0.51]	0.530 [14.25]	1.50 [38.10]	0.025 [0.635]	0.450
GSR65	0.640 ± 0.040 [16.26 \pm 1.02]	0.240 ± 0.025 [6.10 \pm 0.64]	0.780 [19.81]	1.50 [38.10]	0.025 [0.635]	1.300
GSR70	0.640 ± 0.040 [16.26 \pm 1.02]	0.240 ± 0.025 [6.10 \pm 0.64]	0.780 [19.81]	1.50 [38.10]	0.032 [0.813]	1.440
GSR75	1.062 ± 0.062 [26.98 \pm 1.58]	0.250 ± 0.025 [6.35 \pm 0.64]	1.186 [30.12]	1.50 [38.10]	0.032 [0.813]	2.500

POWER DERATING

MARKING

- Style and Size
- Value
- Tolerance and RTC
- Date Code

Precision Hermetic Metal Film Resistors Matched Sets



FEATURES

- Resistance values: 10 Ω - 4.99 M Ω
- Resistance absolute tolerance to ± 0.05 %
- Resistance match to 0.01 %
- Temperature coefficient: ± 15 ppm/ $^{\circ}\text{C}$ (- 55 % to + 125 $^{\circ}\text{C}$)
- Temperature coefficient tracking: 3 ppm/ $^{\circ}\text{C}$

MATCHED SETS

Matched sets provide an economical method of achieving a resistive match in a critical circuit without resorting to networks. Angstrom hermetic metal film resistors (two to twenty or more) are matched to the customer's exact specifications. The matched set is supplied in a single package.

HID Lamp Metal Film Leaded Resistors



A homogenous film of CrSi alloy is deposited on a high-grade ceramic body. The ohmic value is adjusted by means of a helical groove on the resistive layer. Steel copper plated wires are then welded on the stainless steel end caps. The resistor is not coated.

FEATURES

- Metal film technology
- High power in small package (2 W/0309, 2.5 W/0414)
- High stability, reliability during lamp ignitions
- Suitable for high temperature operations
- 1 W version of lamp resistor available on request
- Compatible with lead (Pb)-free and lead containing soldering processes
- Lead (Pb)-free and RoHS compliant



APPLICATIONS

- HID lamps

TECHNICAL SPECIFICATIONS			
DESCRIPTION	PR02L	PR2.5L	PR2.5LS
Resistance Range ⁽¹⁾	2 kΩ to 70 kΩ		
Resistance Tolerance ⁽²⁾	± 5 %, E24 series		
Temperature Coefficient	± 250 ppm/K		
Rated Dissipation P_{70}	2 W	2.5 W	
Maximum Permissible Voltage DC or RMS	500 V	750 V	
Pull Test	≥ 4 N	≥ 2.3 N	

Notes:

- (1) Other values available on request
 (2) Other tolerances available on request

PART NUMBER AND PRODUCT DESCRIPTION ⁽³⁾																	
PART NUMBER ⁽⁴⁾: PR02L00001802JR500																	
P	R	0	2	L	0	0	0	0	1	8	0	2	J	R	5	0	0
MODEL/SIZE	SPECIAL CHARACTER	WIRE TYPE	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING ⁽⁵⁾	SPECIAL										
PR02L0 PR25L0 PR25LS	0 = Neutral	0 = Standard	0 = Standard	3 digit value 1 digit multiplier 1 = *10 ¹ 2 = *10 ² 3 = *10 ³ 4 = *10 ⁴	J = ± 5 %	R2 R5 F5 F2	Up to 2 digits 00 = Standard										
PRODUCT DESCRIPTION: PR02L 5 % R5 18K																	
PR02L	5 %	R5	18 kΩ														
MODEL	TOLERANCE	PACKAGING ⁽⁵⁾	RESISTANCE VALUE														
PR02L PR25L PR25LS	± 5 %	R2 R5 F5 F2	18K = 18 kΩ														

Notes:

- (3) The PART NUMBER is shown to facilitate the introduction of the unified part numbering system
 (4) For historical 12NC ordering information please contact factory
 (5) Please refer to table PACKAGING, see next page

PR02L, PR2.5L, PR2.5LS

Vishay BCcomponents HID Lamp Metal Film Leaded Resistors

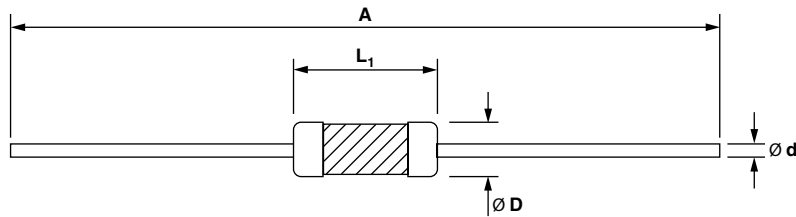


PACKAGING				
MODEL	REEL		LOOSE IN BOX	
	PIECES	CODE	PIECES	CODE
PR02L	5000	R5	5000	F5
PR2.5L	2500	R2	1500	F2
PR2.5LS	2500	R2	-	-

Note:

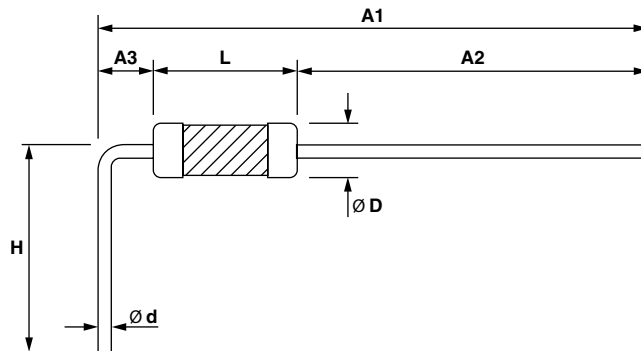
- F2 and F5 are formed leads

DIMENSIONS



DIMENSIONS - resistor types, mass and relevant physical dimensions					
TYPE	L ₁ (mm)	D _{max.} (mm)	Ø d (mm)	A (mm)	MASS (g)/ 100 pieces
PR02L	8.3 ± 0.1	3.55	0.80 ± 0.03	59.0 ± 1.5	60
PR2.5L	15.5 ± 0.3	3.55	0.80 ± 0.03	63.0 ± 1.5	65
PR2.5LS	21.5 ± 0.3	3.55	0.80 ± 0.03	63.0 ± 1.5	75

PREFORMED STYLE



DIMENSIONS - preformed style								
TYPE	L _{max.} (mm)	D _{max.} (mm)	Ø d (mm)	H (mm)	A1 (mm)	A2 (mm)	A3 (mm)	MASS (g)/ 100 pieces
PR02L	8.3 ± 0.1	3.55	0.80 ± 0.03	13.4 ± 1.0	30.7 ± 2.0	19.0 ± 1.0	3.5 ± 1.0	40



TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of IEC 60115-1, category 55/155/56 (rated temperature range - 55 to + 155 °C); "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmosphere conditions according to IEC 60068-1 subclause 5.3, unless otherwise specified. In some instances deviations from IEC applications were necessary for our specified method.

PERFORMANCE				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)
4.8	-	Temperature coefficient	Between - 55 °C and + 155 °C	± 250 ppm/K
	-	Pull test	Pull force in horizontal directions until the product breakdown	
			PR02L	≥ 4 N
			PR2.5L, PR2.5LS	≥ 2.3 N
4.16	21 (U)	Robustness of terminations:		
4.16.2	21 (Ua1)	Tensile all samples	Load 10 N; 10 s	No damage $\pm (0.5 \% R + 0.05 \Omega)$
4.16.3	21 (Ub)	Bending half number of samples	Load 5 N; 4 x 90°	
4.16.4	21 (Uc)	Torsion other half of samples	3 x 360° in opposite direction	

Metal Film Resistors, Military, MIL-R-10509 Qualified, Type RN and MIL-PRF-22684 Qualified, Type RL



FEATURES

- Very low noise (- 40 dB)
- Very low voltage coefficient (5 ppm/V)
- Controlled temperature coefficient
- Flame retardant epoxy coating
- Commercial alternatives to military styles are available with higher power ratings. See appropriate catalog or web page

STANDARD ELECTRICAL SPECIFICATIONS							
MIL STYLE	VISHAY DALE MODEL	MAXIMUM WORKING VOLTAGE	VISHAY DALE® MILITARY APPROVED VALUE RANGE (Ω)				DIELECTRIC STRENGTH V_{AC}
			MIL-R-10509			MIL-PRF-22684	
			CHARACTERISTIC D	CHARACTERISTIC C	CHARACTERISTIC E		
RN50	CMF50	200	-	10R - 100K	10R - 100K	-	450
RN55	CMF55	200	10R - 301K	49R9 - 100K	49R9 - 100K	-	450
RN60	CMF60	300	10R - 1M	49R9 - 499K	49R9 - 499K	-	500
RN65	CMF65	350	10R - 2M	49R9 - 1M	49R9 - 1M	-	900
RN70	CMF70	500	10R - 2.49M	24R9 - 1M	24R9 - 1M	-	900
RL07	CMF07	250	-	-	-	51R - 150K	450
RL20	CMF20	350	-	-	-	4R3 - 470K	700

Note:

- Vishay Dale commercial value range: Extended resistance ranges are available in commercial equivalent types. Please contact us by using the email at the bottom of this page.

TECHNICAL SPECIFICATIONS		
PARAMETER	UNIT	CONDITION
Voltage Coefficient	ppm/V	5 when measured between 10 % and full rated voltage
Insulation Resistance	Ω	$\geq 10^{10}$ min. dry; $\geq 10^8$ min. after moisture test
Operating Temperature Range	$^{\circ}C$	- 65/+ 175 (see derating curves for military range)
Terminal Strength	lb	5 pound pull test for RL07/RL20; 2 pound pull test for all others
Solderability		Continuous satisfactory coverage when tested in accordance with MIL-R-10509 and MIL-PRF-22684



CMF (Military RN and RL)

Metal Film Resistors, Military, MIL-R-10509 Qualified,
Type RN and MIL-PRF-22684 Qualified, Type RL

Vishay Dale

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: RN60D3483FR36 (preferred part numbering format)

MIL STYLE RN50 RN55 RN60 RN65 RN70	CHARACTERISTIC E = 25 ppm C = 50 ppm D = 100 ppm	RESISTANCE VALUE 3 digit significant figure, followed by a multiplier 10R0 = 10 Ω 2152 = 21.5 kΩ 2494 = 2.49 MΩ	TOLERANCE CODE B = ± 0.1 % C = ± 0.25 % D = ± 0.5 % F = ± 1 %	PACKAGING B14 = Tin/Lead, Bulk R36 = Tin/Lead, T/R (Full) RE6 = Tin/Lead, T/R (1000 pieces)	SPECIAL Blank = Standard (Dash Number) (up to 1 digit)
--	--	--	--	---	--

Historical Part Number example: RN60D3483F (will continue to be accepted)

RN60	D	3483	F	R36
MIL STYLE	CHARACTERISTIC	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING

New Global Part Numbering: RL07S471JR36 (preferred part numbering format)

MIL STYLE RL07 RL20	LEAD MATERIAL S = Solderable	RESISTANCE VALUE 2 digit significant figure, followed by a multiplier 4R3 = 4.3 Ω 202 = 2.0 kΩ 474 = 470 kΩ	TOLERANCE CODE G = ± 2 % J = ± 5 %	PACKAGING B14 = Tin/Lead, Bulk R36 = Tin/Lead, T/R (Full) RE6 = Tin/Lead, T/R (1000 pieces)
----------------------------------	--	--	---	---

Historical Part Number example: RL07S471J (will continue to be accepted)

RL07	S	471	J	R36
MIL STYLE	LEAD MATERIAL	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING

MATERIAL SPECIFICATIONS

Element:	Nickel-chrome alloy
Coating:	Flame retardant epoxy, formulated for superior moisture protection
Core:	Fire-cleaned high purity ceramic
Termination:	Standard lead material is solder-coated copper. Solderable and weldable.

ENVIRONMENTAL SPECIFICATIONS

General:	Environmental performance is shown in the Environmental Performance table. Test methods are those specified in MIL-R-10509 and MIL-PRF-22684.
Shelf Life:	Resistance shifts due to storage at room temperature are negligible.

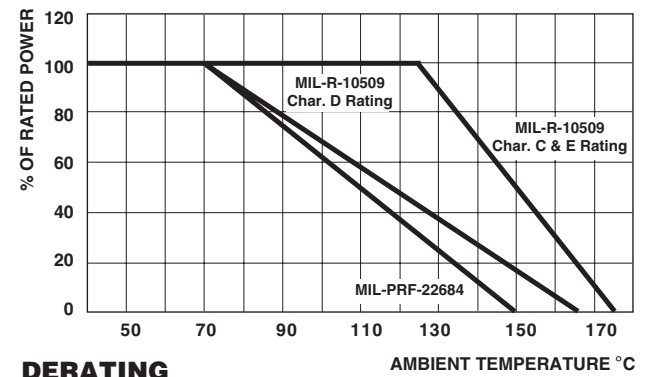
APPLICABLE MIL-SPECS

MIL-R-10509 and MIL-PRF-22684: The CMF models meet or exceed the electrical, environmental and dimensional requirements of MIL-R-10509 and MIL-PRF-22684.

Noise: Vishay Dale metal film resistors have exceptionally low noise level. Average for standard resistance range is 0.10 μV per V over a decade of frequency, with low and intermediate resistance values typically below 0.05 μV per V.

CAGE CODE: 91637

Vishay Dale CMF resistors have an operating temperature range of - 65 °C to + 175 °C. They must be derated according to the following curves:



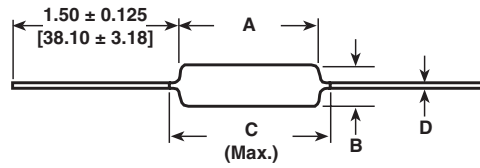
CMF (Military RN and RL)



Vishay Dale

Metal Film Resistors, Military, MIL-R-10509 Qualified,
Type RN and MIL-PRF-22684 Qualified, Type RL

DIMENSIONS in inches [millimeters]



VISHAY DALE MODEL	A	B	C (Max.)	D
CMF50	0.150 ± 0.020 [3.81 ± 0.51]	0.065 ± 0.015 [1.65 ± 0.38]	0.244 [6.20]	0.016 ± 0.002 [0.41 ± 0.05]
CMF55	0.240 ± 0.020 [6.10 ± 0.51]	0.090 ± 0.008 [2.29 ± 0.20]	0.278 [7.06] ⁽¹⁾	0.025 ± 0.002 [0.64 ± 0.05]
CMF60	0.344 ± 0.031 [8.74 ± 0.79]	0.145 ± 0.015 [3.68 ± 0.38]	0.425 [10.80]	0.025 ± 0.002 [0.64 ± 0.05]
CMF65	0.562 ± 0.031 [14.27 ± 0.79]	0.180 ± 0.015 [4.57 ± 0.38]	0.687 [17.45]	0.025 ± 0.002 [0.64 ± 0.05]
CMF70	0.562 ± 0.031 [14.27 ± 0.79]	0.180 ± 0.015 [4.57 ± 0.38]	0.687 [17.45]	0.032 ± 0.002 [0.81 ± 0.05]
CMF07	0.240 ± 0.020 [6.10 ± 0.51]	0.090 ± 0.008 [2.29 ± 0.20]	0.278 [7.06]	0.025 ± 0.002 [0.64 ± 0.05]
CMF20	0.375 ± 0.040 [9.53 ± 1.02]	0.145 ± 0.015 [3.68 ± 0.38]	0.425 [10.80]	0.032 ± 0.002 [0.81 ± 0.05]

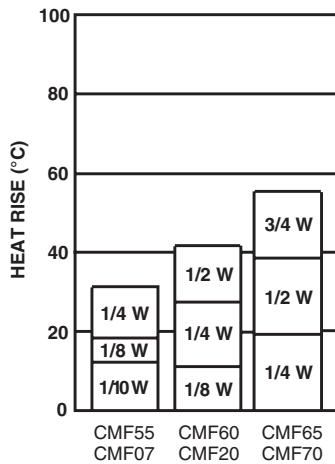
Note:

⁽¹⁾ 0.290" [7.37] for ± 0.25 % and ± 0.1 % resistance tolerances.

MILITARY POWER RATING			
WATTAGE	MILITARY QUALIFIED		
	MIL-R-10509		MIL-PRF-22684
	AT + 70 °C (D)	AT + 125 °C (C and E)	AT + 70 °C
0.05	-	RN50	-
0.10	-	RN55	-
0.125	RN55	RN60	-
0.25	RN60	RN65	RL07
0.50	RN65	RN70	RL20
1.0	RN70	-	-

Note:

• Commercial equivalents of military styles are available with higher power ratings. Consult factory.



HEAT RISE

The increase in resistors surface temperature due to rated load is shown in the chart above. Resistor temperature = heat rise + ambient temperature.



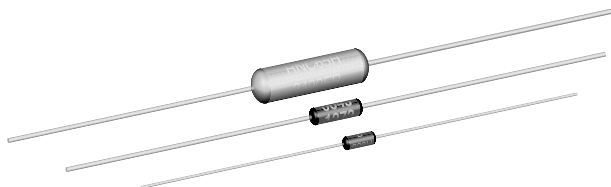
MARKING	
Characteristics: D = 100 ppm, C = 50 ppm, E = 25 ppm Tolerance: F = 1 %, D = 0.5 %, C = 0.25 %, B = 0.1 % Value = three significant figures and multiplier J = JAN (joint Army - Navy) brand	
RN50: (3 lines)	RN55, RN60, RN65, RN70 (4 lines)
J50D JAN, type, characteristic	DALE Company Logo
1211 Value	0137J 4 digit date code and JAN brand
F137 Tolerance and 3 digit date code	RN55D Type and characteristic
	1211F Value and Tolerance

Note:

- RL series are color banded per MIL-PRF-22684

PERFORMANCE				
REQUIREMENT	MIL-R-10509			MIL-PRF-22684
	CHARACTERISTIC D	CHARACTERISTIC C	CHARACTERISTIC E	
MIL Temperature Coefficient	+ 200 - 500 ppm/°C	± 50 ppm/°C	± 25 ppm/°C	± 200 ppm/°C
Applicable Vishay Dale Temperature Coefficient	± 100 ppm/°C	± 50 ppm/°C	± 25 ppm/°C	± 200 ppm/°C
TEST	MIL max.	MIL max.	MIL max.	MIL max.
Thermal Shock	± 0.50 % ΔR	± 0.25 % ΔR	± 0.25 % ΔR	± 1.00 % ΔR
Short Time Overload	± 0.50 % ΔR	± 0.25 % ΔR	± 0.25 % ΔR	± 0.50 % ΔR
Low Temperature Operation	± 0.50 % ΔR	± 0.25 % ΔR	± 0.25 % ΔR	± 0.50 % ΔR
Moisture Resistance	± 1.50 % ΔR	± 0.50 % ΔR	± 0.50 % ΔR	± 1.50 % ΔR
Shock	± 0.50 % ΔR	± 0.25 % ΔR	± 0.25 % ΔR	± 0.50 % ΔR
Vibration	± 0.50 % ΔR	± 0.25 % ΔR	± 0.25 % ΔR	± 0.50 % ΔR
Load Life	± 1.00 % ΔR	± 0.50 % ΔR	± 0.50 % ΔR	± 2.00 % ΔR
Dielectric Withstanding Voltage	± 0.50 % ΔR	± 0.25 % ΔR	± 0.25 % ΔR	± 0.50 % ΔR
Effect of Solder	± 0.50 % ΔR	± 0.10 % ΔR	± 0.10 % ΔR	± 0.50 % ΔR

Metal Film Resistors, Military/Established Reliability, MIL-PRF-55182 Qualified, Type RNC, Characteristics J, H, K



FEATURES

- Meets requirements of MIL-PRF-55182
- Very low noise (- 40 dB)
- Verified Failure Rate (Contact factory for current level)
- 100 % stabilization and screening tests. Group A testing, if desired, to customer requirements
- Controlled temperature coefficient
- Epoxy coating provides superior moisture protection
- Standard lead on RNC product is solderable and weldable
- Traceability of materials and processing
- Monthly acceptance testing
- Vishay Dale has complete capability to develop specific reliability programs designed to customer requirements
- Extensive stocking program at distributors and factory on RNC50, RNC55, RNC60 and RNC65
- For MIL-PRF-55182 Characteristics E and C product, see Vishay Angstrom's HDN (Military RNR/RNN) data sheet

STANDARD ELECTRICAL SPECIFICATIONS									
VISHAY DALE MODEL	MIL-PRF-55182 TYPE	POWER RATING		RESISTANCE TOLERANCE %	MAXIMUM WORKING VOLTAGE	RESISTANCE RANGE (Ω) ⁽¹⁾			LIFE FAILURE RATE ⁽¹⁾
		$P_{70^\circ\text{C}}$ W	$P_{125^\circ\text{C}}$ W			100 ppm/ $^\circ\text{C}$ (K)	50 ppm/ $^\circ\text{C}$ (H)	25 ppm/ $^\circ\text{C}$ (J)	
ERC50	RNC50, RNR50	0.10	0.05	$\pm 0.1, \pm 0.5, \pm 1$	200	10R - 796K	10R - 796K	10R - 796K	M, P, R, S
ERC55	RNC55, RNR55	0.125	0.10	$\pm 0.1, \pm 0.5, \pm 1$	200	10R - 2M0	10R - 2M0	10R - 2M0	M, P, R, S
ERC55..200	RNC60, RNR60	0.25	0.125	$\pm 0.1, \pm 0.5, \pm 1$	250	10R - 3M01	10R - 3M01	10R - 3M01	M, P, R, S
ERC65	RNC65, RNR65	0.50	0.25	$\pm 0.1, \pm 0.5, \pm 1$	300	10R - 3M01	10R - 3M01	10R - 3M01	M, P, R
ERC70	RNC70, RNR70	0.75	0.50	$\pm 0.1, \pm 0.5, \pm 1$	350	10R - 3M01	10R - 3M01	10R - 3M01	M, P, R

Note:

⁽¹⁾ Consult factory for current QPL failure rates
Standard resistance tolerances: $\pm 0.1\%$ (B), $\pm 0.5\%$ (D) and $\pm 1\%$ (F). $\pm 0.1\%$ not applicable to Characteristic K

TECHNICAL SPECIFICATIONS		
PARAMETER	UNIT	CONDITION
Voltage Coefficient, max.	ppm/ $^\circ\text{C}$	5/V when measured between 10 % and full rated voltage
Dielectric Strength	V_{AC}	RNC50, RNC55 and RNC60 = 450; RNC65 and RNC70 = 900
Insulations Resistance	Ω	$\geq 10^{11}$ dry; $\geq 10^9$ after moisture test
Operating Temperature Range	$^\circ\text{C}$	- 65/+ 175
Terminal Strength	lb	2 lb pull test on RNC50, RNC55, RNC60 and RNC65; 4.5 lb pull test on RNC70
Solderability		Continuous satisfactory coverage when tested in accordance with MIL-STD-202, Method 208
Weight	g	RNC50 = 0.11; RNC55 = 0.35; RNC60 = 0.35; RNC65 = 0.84; RNC70 = 1.60

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: RNC55H2152FRR R36 (preferred part numbering format)

R	N	C	5	5	H	2	1	5	2	F	R	R	3	6			
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	--	--	--

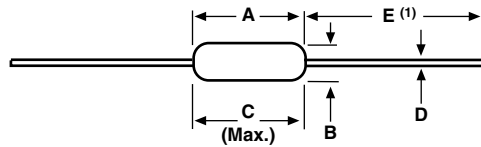
MIL STYLE	CHARACTERISTICS	RESISTANCE VALUE	TOLERANCE CODE	FAILURE RATE	PACKAGING	SPECIAL
RNC = Solderable/Weldable RNR = Solderable only (see Standard Electrical Specifications table)	J = ± 25 ppm H = ± 50 ppm K = ± 100 ppm	3 digit significant figure, followed by a multiplier 10R0 = 10 Ω 2152 = 21.5 k Ω 3014 = 3.01 M Ω	B = $\pm 0.1\%$ D = $\pm 0.5\%$ F = $\pm 1\%$	M = 1.0%/1000 h P = 0.1%/1000 h R = 0.01%/1000 h S = 0.001%/1000 h	B14 = Tin/Lead, Bulk R36 = Tin/Lead, T/R (Full; 50, 55, 60) R64 = Tin/Lead, T/R (Full; 65, 70) RE6 = Tin/Lead, T/R (1000 pieces)	Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable 4 = Hot Solder Dip (70's) 31 = Hot Solder Dip (50's) 65 = Hot Solder Dip (55's) 65 = Hot Solder Dip (65's) 201 = Hot Solder Dip (60's)

Historical Part Number example: RNC55H2152FR R36 (will continue to be accepted)

RNC55	H	2152	F	R	R36
MIL STYLE	CHARACTERISTIC	RESISTANCE VALUE	TOLERANCE CODE	FAILURE RATE	PACKAGING



DIMENSIONS in inches [millimeters]



Note:

(1) 1.08 ± 0.125 [27.43 ± 3.18] if tape and reel

VISHAY DALE MODEL	MIL-PRF-55182 STYLE	A	B	C (Max.)	D	E
ERC50	RNC50, RNR50	0.150 ± 0.020 [3.81 ± 0.51]	0.070 ± 0.010 [1.78 ± 0.25]	0.187 [4.75]	0.016 ± 0.002 [0.41 ± 0.05]	1.25 ± 0.266 [31.75 ± 6.76]
ERC55	RNC55, RNR55	$0.250 + 0.031 - 0.046$ [6.35 + 0.79 - 1.17]	0.094 ± 0.012 [2.39 ± 0.30]	0.300 [7.62]	0.025 ± 0.002 [0.64 ± 0.05]	1.50 ± 0.125 [38.1 ± 3.18]
ERC55..200	RNC60, RNR60	0.280 ± 0.020 [7.11 ± 0.51]	0.097 ± 0.012 [2.46 ± 0.30]	0.350 [8.89]	0.025 ± 0.002 [0.64 ± 0.05]	1.50 ± 0.125 [38.1 ± 3.18]
ERC65	RNC65, RNR65	0.562 ± 0.031 [14.27 ± 0.79]	0.180 ± 0.015 [4.57 ± 0.38]	0.687 [17.45]	0.025 ± 0.002 [0.64 ± 0.05]	1.50 ± 0.125 [38.1 ± 3.18]
ERC70	RNC70, RNC70	0.562 ± 0.031 [14.27 ± 0.79]	0.180 ± 0.015 [4.57 ± 0.38]	0.687 [17.45]	0.032 ± 0.002 [0.81 ± 0.05]	1.50 ± 0.125 [38.1 ± 3.18]

MATERIAL SPECIFICATIONS			
Element:	Vacuum-deposited nickel-chrome alloy	Encapsulation:	Specially formulated epoxy compound
Core:	Fire-cleaned high purity ceramic	Termination:	Standard lead material is solder-coated copper Solderable and weldable per MIL-STD-1276, Type C.

POWER RATING

Power ratings are based on the following two conditions:

- ± 2.0 % maximum ΔR in 10 000 h load life
- + 175 °C maximum operating temperature

APPLICABLE MIL-SPECIFICATIONS

MIL-PRF-55182:

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

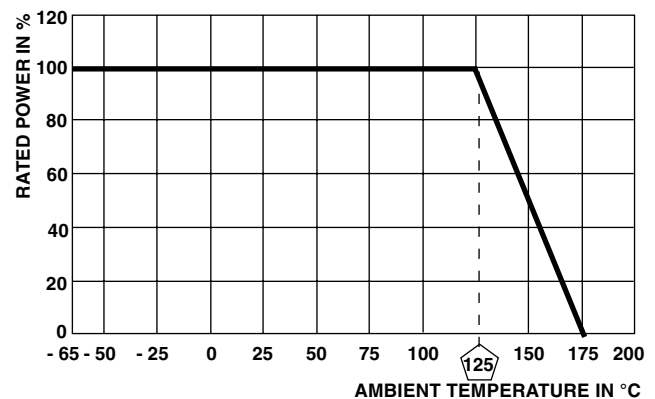
MIL-R-10509:

MIL-PRF-55182 supercedes MIL-R-10509 on new designs. The ERC series meets or exceeds MIL-R-10509 requirements.

Documentation:

Qualification and failure rate verification test data is maintained by Vishay Dale and is available upon request. Lot traceability and identification data is maintained by Vishay Dale for five years.

Vishay Dale ERC resistors have an operating temperature range of - 65 °C to + 175 °C. They must be derated according to the following curve:

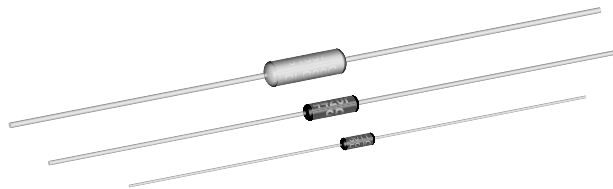


DERATING

CAGE CODE: 91637

MARKING
- Per MIL-PRF-55182

Metal Film Resistors, Military/Established Reliability, MIL-PRF-39017 Qualified, Type RLR



FEATURES

- Meets requirements of MIL-PRF-39017
- Failure Rate: Verified Failure Rate (Contact factory for current level)
- Epoxy coated construction provides superior moisture protection
- Traceability of materials and processing
- Monthly lot acceptance testing
- Very low noise (-40 dB)
- Extensive stocking program at distributors and factory in $\pm 1\%$ and $\pm 2\%$ tolerances
- Vishay Dale has complete capability to develop specific reliability programs designed to customer requirements

STANDARD ELECTRICAL SPECIFICATIONS							
VISHAY DALE MODEL	MIL-PRF-39017 STYLE	POWER RATING $P_{70^\circ\text{C}}$, W	RESISTANCE RANGE Ω ⁽¹⁾	RESISTANCE TOLERANCE %	TEMPERATURE COEFFICIENT ppm/ $^\circ\text{C}$	MAXIMUM WORKING VOLTAGE	LIFE FAILURE RATE ⁽²⁾
ERL05	RLR05	0.125	4R7 - 1M0	$\pm 1, \pm 2$	100	200	M, P, R, S
ERL07	RLR07	0.25	1R0 - 10M	$\pm 1, \pm 2$	100	250	M, P, R, S
ERL20	RLR20	0.50	4R3 - 3M01	$\pm 1, \pm 2$	100	350	M, P, R
ERL32	RLR32	1.0	1R0 - 2M7	$\pm 1, \pm 2$	100	500	M, P, R

Notes:

⁽¹⁾ Extended Resistance Range: DSCC has created a series of drawings intended to support extended resistance ranges left otherwise void by the discontinuation of MIL-R-39008 RCR carbon composition resistors. Vishay Dale is listed as a resource on these drawings as follows:

DSCC DRAWING NUMBER	VISHAY DALE MODEL	POWER RATING $P_{70^\circ\text{C}}$, W	RESISTANCE RANGE Ω	RESISTANCE TOLERANCE %	TEMPERATURE COEFFICIENT ppm/ $^\circ\text{C}$	MAXIMUM WORKING VOLTAGE
98020	ERL05..36, ERL05..37 ⁽³⁾	0.125	1M1 - 22M	$\pm 2, \pm 5, \pm 10$	350	200
99011	ERL07..100, ERL07..101 ⁽³⁾	0.25	11M - 22M	$\pm 2, \pm 5, \pm 10$	350	250
98021	ERL20..36, ERL20..37 ⁽³⁾	0.50	3M3 - 22M	$\pm 2, \pm 5, \pm 10$	350	350
98022	ERL32..36, ERL32..37 ⁽³⁾	1.0	3M0 - 22M	$\pm 2, \pm 5, \pm 10$	350	350
97004	ERL62..1, ERL62..2 ⁽³⁾	2.0	10R - 2M7 3M0 - 22M	$\pm 1, \pm 2, \pm 5, \pm 10$	100 350	500

These drawings can be viewed at: www.dscclia.mil/Programs/MilSpec/ListDwgs.asp?DocType=DSCCdwg

⁽²⁾ Consult factory for current QPL failure rates

⁽³⁾ Hot solder dipped leads

TECHNICAL SPECIFICATIONS		
PARAMETER	UNIT	CONDITION
Voltage Coefficient, max.	ppm/ $^\circ\text{C}$	5/V when measured between 10% and full rated voltage
Dielectric Strength	V_{AC}	RLR05 = 300; RLR07 and RLR20 = 500; RLR32 = 1000
Insulations Resistance	Ω	$\geq 10^9$ min. dry; $\geq 10^{11}$ min. after moisture test
Operating Temperature Range	$^\circ\text{C}$	-65 to +150
Terminal Strength	lb	2 lb pull test on RLR05; 5 lb pull test on all other sizes
Solderability		Continuous satisfactory coverage when tested in accordance with MIL-STD-202, Method 208
Weight	g	RLR05 = 0.11; RLR07 = 0.35; RLR20 = 0.75; RLR32 = 1.50

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: RLR07C3001FRR36 (preferred part numbering format)

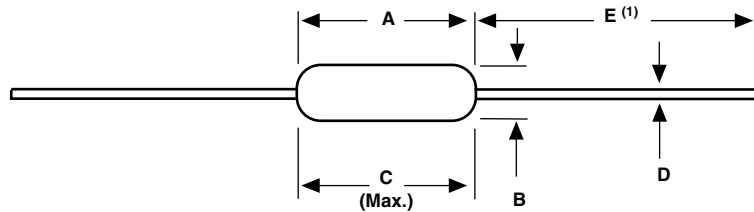
R	L	R	0	7	C	3	0	0	1	F	R	R	3	6			
MIL STYLE		LEAD MATERIAL		RESISTANCE VALUE		TOLERANCE CODE		FAILURE RATE		PACKAGING			SPECIAL				
RLR05 RLR07 RLR20 RLR32		C = Solderable/ Weldable		3 digit significant figure, followed by a multiplier 1R00 = 1.0 Ω 3302 = 33 k Ω 1005 = 10 M Ω		F = $\pm 1\%$ G = $\pm 2\%$		M = 1.0%/1000 h P = 0.1%/1000 h R = 0.01%/1000 h S = 0.001%/1000 h		B14 = Tin/Lead, Bulk R36 = Tin/Lead, T/R (Full, except 32's) R64 = Tin/Lead, T/R (Full; 32's only) RE6 = Tin/Lead, T/R (1000 pieces)			Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable 1 = Hot Solder Dip (32's) 11 = Hot Solder Dip (20's) 19 = Hot Solder Dip (05's) 23 = Hot Solder Dip (07's)				

Historical Part Number example: RLR07C3001FR (will continue to be accepted)

RLR07	C	3001	F	R	R36
MIL STYLE	LEAD MATERIAL	RESISTANCE VALUE	TOLERANCE CODE	FAILURE RATE	PACKAGING



DIMENSIONS in inches [millimeters]



Note:

(1) 1.08 ± 0.125 [27.43 ± 3.18] if tape and reel

VISHAY DALE MODEL	A	B	C (Max.)	D	E
ERL05	0.150 ± 0.020 [3.81 ± 0.51]	0.066 ± 0.008 [1.68 ± 0.21]	0.187 [4.75]	0.016 ± 0.002 [0.41 ± 0.05]	1.25 ± 0.266 [31.75 ± 6.76]
ERL07	$0.250 \pm 0.031 - 0.046$ [6.35 ± 0.79 - 1.17]	0.090 ± 0.008 [2.29 ± 0.21]	0.300 [7.62]	0.025 ± 0.002 [0.64 ± 0.05]	1.50 ± 0.125 [38.10 ± 3.18]
ERL20	0.375 ± 0.041 [9.53 ± 1.04]	0.138 ± 0.023 [3.51 ± 0.58]	0.450 [11.43]	0.032 ± 0.002 [0.81 ± 0.05]	1.50 ± 0.125 [38.10 ± 3.18]
ERL32	0.562 ± 0.031 [14.27 ± 0.79]	0.190 ± 0.015 [4.83 ± 0.38]	0.625 [15.87]	$0.032 + 0.002 - 0.001$ [0.81 + 0.05 - 0.03]	1.50 ± 0.125 [38.10 ± 3.18]
ERL62	$0.562 + 0.031 - 0.042$ [14.27 + 0.79 - 1.07]	0.230 ± 0.015 [5.84 ± 0.38]	0.650 [16.51]	$0.032 + 0.002 - 0.001$ [0.81 + 0.05 - 0.03]	1.50 ± 0.125 [38.10 ± 3.18]

MATERIAL SPECIFICATIONS			
Element:	Vacuum-deposited nickel-chrome alloy	Encapsulation:	Specially formulated epoxy compound
Core:	Fire-cleaned high purity ceramic	Termination:	Standard lead material is solder-coated copper Solderable and weldable per MIL-STD-1276, Type C.

APPLICABLE MIL-SPECIFICATIONS

MIL-PRF-39017:

The ERL series meets the electrical, environmental and dimensional requirements of MIL-PRF-39017.

MIL-PRF-22684:

MIL-PRF-39017 supercedes MIL-PRF-22684 on new designs. The ERC series meet or exceed MIL-PRF-22684 requirements.

Documentation:

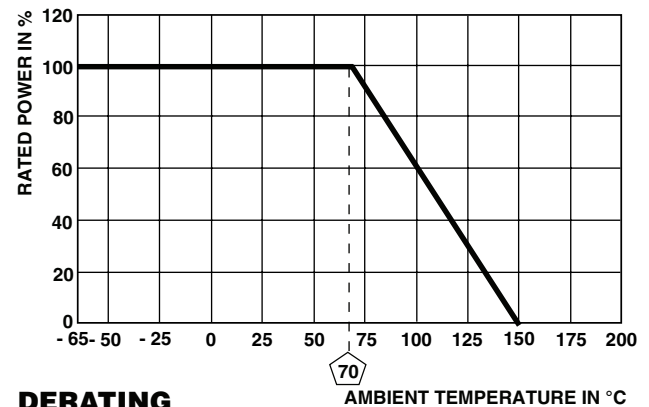
Qualification and failure rate verification test data is maintained by Vishay Dale and is available upon request. Lot traceability and identification data is maintained by Vishay Dale for five years.

CAGE CODE: 91637

POWER RATING

Power ratings are based on the following two conditions:

- ± 2.0 % maximum R in 2000 h load life
- + 150 °C maximum operating temperature



DERATING

MARKING
- Per MIL-PRF-39017

Hermetic Metal Film Resistors, Military/Established Reliability, MIL-PRF-55182 Qualified, Type RNR, Characteristics E and C



For the highest degree of reliability, stability and uniformity of construction, Vishay Angstrom hermetically-sealed metal film resistors are unquestionably the first choice. The true glass-to-metal hermetic enclosure seals the resistor element in an inert gas atmosphere and protects it from virtually all adverse environmental influences. The glass enclosure will withstand in excess of 3000 psi external pressure without leakage. The reliability and stability of Vishay Angstrom hermetically-sealed resistors have been established by their use in nearly every military, missile, aerospace and oceanography program having the most demanding applications and the most hostile environments.

FEATURES

- Qualified to MIL-PRF-55182 Characteristics E and C (E only for RNR75)
- Performance exceeds the requirements of MIL-PRF-55182
- “S” Level reliability
- Hermetic glass enclosure is impervious to harmful environments
- Inert gas filled
- Low noise (- 40 dB)
- Standard lead on the RNR product is solderable and on the RNN is weldable
- MODEL RNC: For characteristics E and C (per MIL-PRF-55182) terminal model RNR shall be used as a substitute.
- For MIL-PRF-55182 Characteristics J, H and K product, see Vishay Dale’s ERC (Military RNC/RNR) data sheet

STANDARD ELECTRICAL SPECIFICATIONS

VISHAY ANGSTROM MODEL	MIL- PRF- 55182 STYLE	POWER RATING		MAXIMUM WORKING VOLTAGE	TEMPERATURE CHARACTERISTIC ⁽¹⁾ (ppm/°C)	RESISTANCE TOLERANCE (%)	QUALIFIED RESISTANCE RANGE ⁽²⁾ (Ω)		LIFE FAILURE RATE ⁽³⁾
		$P_{70^{\circ}\text{C}}$ W	$P_{125^{\circ}\text{C}}$ W				MIN.	MAX.	
HDN55	RNR55, RNN55	0.125	0.10	200	E = ± 25 C = ± 50	B = ± 0.1 D = ± 0.5 F = ± 1.0	10	1.21M	M, P, R, S
HDN57	RNR57, RNN57	0.25	0.125	250	E = ± 25 C = ± 50	F = ± 1.0	49.9	200K	M, P, R, S
HDN60	RNR60, RNN60	0.25	0.125	250	E = ± 25 C = ± 50	B = ± 0.1 D = ± 0.5 F = ± 1.0	10	2.49M	M, P, R, S
HDN65	RNR65, RNN65	0.50	0.25	300	E = ± 25 C = ± 50	B = ± 0.1 D = ± 0.5 F = ± 1.0	24.9	4.99M	M, P
HDN70	RNR70, RNN70	0.75	0.50	350	E = ± 25 C = ± 50	B = ± 0.1 D = ± 0.5 F = ± 1.0	24.9	4.99M	M, P
HDN75	RNR75, RNN75	2.0	1.0	750	E = ± 25	B = ± 0.1 D = ± 0.5 F = ± 1.0	49.9	1.21M	M

Notes:

- ⁽¹⁾ Temperature characteristics E and C designate hermetically-sealed enclosure.
- ⁽²⁾ Standard resistance values should be selected from the Resistance-Tolerance Decade table.
B tolerance available in all values.
- ⁽³⁾ Contact factory for current QPL failure rates.



Hermetic Metal Film Resistors, Military/Established
Reliability, MIL-PRF-55182 Qualified, Type RNR,
Characteristics E and C

Vishay Angstrom

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: RNR55E49R9BSM76 (preferred part number format)

R **N** **R** **5** **5** **E** **4** **9** **R** **9** **B** **S** **M** **7** **6**

MIL STYLE (1)	CHARACTERISTIC (2)	RESISTANCE VALUE	TOLERANCE CODE	FAILURE RATE	PACKAGING	SPECIAL
RNR = Solderable only RNN = Weldable only (see Standard Electrical Specifications Table)	E = 25 ppm C = 50 ppm J = 25 ppm (75 only)	3 digit significant figure, followed by a multiplier 10R0 = 10 Ω 49R9 = 49.9 Ω 2152 = 21.5 kΩ 3014 = 3.01 MΩ	B = ± 0.1 % D = ± 0.5 % F = ± 1.0 %	M = 1.0 %/1000 h P = 0.1 %/1000 h R = 0.01 %/1000 h S = 0.001 %/1000 h	M76 = Foil Bag (55, 57, 60, 65, 70) M77 = Foil Bag (75 only) RJ7 = Reel (55, 57, 60) RJ8 = Reel (65, 70, 75) K36 = Ammo (55, 57, 60) K18 = Ammo (65, 70, 75)	Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable 65 = Hot Solder Dip (55's) 1 = Hot Solder Dip (57's) 1 = Hot Solder Dip (60's) 65 = Hot Solder Dip (65's) 4 = Hot Solder Dip (70's) 1 = Hot Solder Dip (75's)

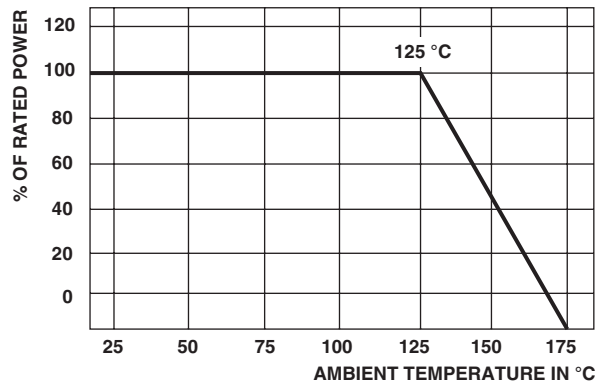
Historical Part Numbering: RNR55E49R9BS (will continue to be accepted)

RNR55	E	49R9	B	S
MIL STYLE	CHARACTERISTIC	RESISTANCE VALUE	TOLERANCE CODE	FAILURE RATE

Notes:

- (1) MODEL RNC: For characteristics C and E (per MIL-PRF-55182) terminal model RNR shall be used as a substitute.
- (2) For RNR75 only: Characteristic J (± 25 ppm/°C) is also available

POWER DERATING



CAGE CODE: 17745

HDN (Military RNR/RNN)



Vishay Angstrom

Hermetic Metal Film Resistors, Military/Established
Reliability, MIL-PRF-55182 Qualified, Type RNR,
Characteristics E and C

MARKING	
55, 57	EXAMPLE RNR55C1002FS
- Date Code, RTC Code	005C
- Resistance Code	1002
- Tolerance, Failure Rate, Terminal, JAN	FSRJ
- Manufacturer Identification	A
60, 65, 70, 75	EXAMPLE RNR60E2501FS
- Source Code	17745
- Date Code, JAN	0005J
- Style, Size, RTC Code	RNR60E
- Resistance Code, Tolerance, Failure Rate	2501FS

COMPARISON OF VISHAY ANGSTROM CHARACTERISTICS TO MIL SPECIFICATION LIMIT (1)							
MILITARY STYLE (RNR/RNN)	LOAD LIFE Limit ± 2.0 %	MOISTURE (2) Limit ± 0.2 %	SHOCK Limit ± 0.2 %	VIBRATION Limit ± 0.2 %	HIGH TEMPERATURE EXPOSURE Limit ± 2.0 %	LOW TEMPERATURE OPERATION Limit ± 0.15 %	RESISTANCE TO SOLDERING HEAT Limit ± 0.1 %
55	< 0.2 %	< 0.03 %	< 0.02 %	< 0.02 %	< 0.4 %	< 0.004 %	< 0.02 %
57	< 0.3 %	< 0.02 %	< 0.01 %	< 0.01 %	< 0.3 %	< 0.005 %	< 0.01 %
60	< 0.3 %	< 0.03 %	< 0.01 %	< 0.01 %	< 0.4 %	< 0.004 %	< 0.02 %
65	< 0.5 %	< 0.03 %	< 0.01 %	< 0.01 %	< 0.4 %	< 0.003 %	< 0.01 %
70	< 0.6 %	< 0.01 %	< 0.01 %	< 0.01 %	< 0.4 %	< 0.006 %	< 0.01 %
75	< 0.5 %	< 0.02 %	< 0.01 %	< 0.01 %	< 0.3 %	< 0.010 %	< 0.01 %

Notes:

(1) This typical data is taken from the average resistance shifts from numerous values. The actual shifts are dependent on the value.

(2) Any shift during moisture testing is due to the "load" (mini-load life) portion of the test and not due to the effect of moisture.

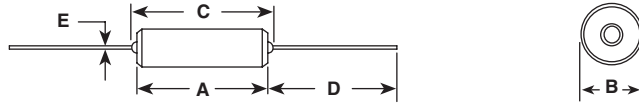


HDN (Military RNR/RNN)

Hermetic Metal Film Resistors, Military/Established
Reliability, MIL-PRF-55182 Qualified, Type RNR,
Characteristics E and C

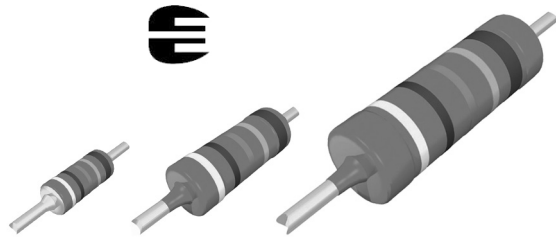
Vishay Angstrom

DIMENSIONS PER MIL-PRF-55182 in inches [millimeters]



VISHAY ANGSTROHM MODEL	MIL- PRF- 55182 STYLE	A LENGTH	B DIAMETER	C CL TO CL (MAX.)	D LENGTH ± 0.125 [± 3.18]	E DIAMETER ± 0.002 [± 0.051]	D APPROX. WEIGHT (g)
HDN55	RNR55, RNN55	0.250 + 0.031 - 0.046 [6.35 + 0.78 - 1.17]	0.109 ± 0.031 [2.77 ± 0.78]	0.379 [9.63]	1.50 [38.10]	0.025 [0.635]	0.337
HDN57	RNR57, RNN57	0.281 ± 0.062 [7.14 ± 1.57]	0.155 ± 0.015 [3.94 ± 0.38]	0.467 [11.86]	1.25 [31.75]	0.025 [0.635]	0.405
HDN60	RNR60, RNN60	0.375 + 0.062 - 0.115 [9.53 + 1.57 - 2.92]	0.125 ± 0.040 [3.18 ± 1.02]	0.561 [14.25]	1.50 [38.10]	0.025 [0.635]	0.450
HDN65	RNR65, RNN65	0.625 + 0.031 - 0.094 [15.8 + 0.787 - 2.39]	0.188 + 0.062 - 0.031 [4.78 + 1.57 - 0.787]	0.780 [19.81]	1.50 [38.10]	0.025 [0.635]	1.30
HDN70	RNR70, RNN70	0.750 + 0.125 - 0.250 [19.05 + 3.18 - 6.35]	0.250 + 0.078 - 0.090 [6.35 + 1.98 - 2.29]	0.939 [23.85]	1.50 [38.10]	0.032 [0.813]	1.44
HDN75	RNR75, RNN75	1.062 ± 0.062 [26.98 ± 1.58]	0.375 + 0.062 - 0.150 [9.53 + 1.57 - 3.81]	1.186 [30.12]	1.50 [38.10]	0.032 [0.813]	2.500

Leaded Resistors with Established Reliability (CECC 40101-806, Version E)



MBA/SMA 0204 VG06, MBB/SMA 0207 VG06 and MBE/SMA 0414 VG06 leaded thin film resistors with established reliability are the perfect choice for all high-reliability applications typically found in the fields of military, aircraft and spacecraft electronics. These versions supplement the families of professional and precision leaded resistors MBA/SMA 0204, MBB/SMA 0207 and MBE/SMA 0414.

FEATURES

- Approved according to CECC 40101-806, version E
- Established reliability, failure rate level E7
- Advanced thin film technology
- Excellent overall stability: Class 0.5
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- Military
- Avionics
- Space

METRIC SIZE

DIN:	0204	0207	0414
CECC:	A	B	D

TECHNICAL SPECIFICATIONS

DESCRIPTION	MBA/SMA 0204	MBB/SMA 0207	MBE/SMA 0414
CECC Size, Style	A	B	D
Resistance Range	1 Ω to 5.11 M Ω	1 Ω to 10 M Ω	1 Ω to 21.5 M Ω
Resistance Tolerance	$\pm 1\%$; $\pm 0.1\%$		
Temperature Coefficient	± 50 ppm/K; ± 15 ppm/K		
Climatic Category (LCT/UCT/days)	55/155/56	55/155/56	55/155/56
Rated Dissipation, P_{70}	0.4 W	0.6 W	1.0 W
Operating Voltage, U_{max} . AC/DC	200 V	350 V	500 V
Film Temperature	155 $^{\circ}$ C	155 $^{\circ}$ C	155 $^{\circ}$ C
Max. Resistance Change at P_{70} for Resistance Range, $\Delta R/R$ After:	1 Ω to 332 k Ω	1 Ω to 1 M Ω	1 Ω to 2.43 M Ω
1000 h	0.5 %		0.4 %
8000 h	1.0 %		0.8 %
Specified Lifetime	8000 h		
Permissible Voltage Against Ambient (Insulation):			
1 Min; U_{ins}	300 V	500 V	800 V
Continuous	75 V	75 V	75 V
Failure Rate Level	E7		
Failure Rate	$0.7 \times 10^{-9}/h$	$0.3 \times 10^{-9}/h$	$0.1 \times 10^{-9}/h$

Note:

- The failure rate level E7 corresponds to MIL Level R.



MBA/SMA 0204 VG06, MBB/SMA 0207 VG06, MBE/SMA 0414 VG06

Leaded Resistors with Established Reliability
(CECC 40101-806, Version E)

Vishay Beyschlag

PART NUMBER AND PRODUCT DESCRIPTION																	
PART NUMBER: MBB0207CC1001FCT00																	
M	B	B	0	2	0	7	C	C	1	0	0	1	F	C	T	0	0
MODEL/SIZE			SPECIAL CHARACTER		TCR/MATERIAL		VALUE			TOLERANCE		PACKAGING (1)		SPECIAL			
MBA0204 = MBA/SMA 0204 MBB0207 = MBB/SMA 0207 MBE0414 = MBE/SMA 0414			C = VG06 (CECC E7)		E = 15 ppm C = 50 ppm Z = Jumper		3 digit value 1 digit multiplier MULTIPLIER			B = ± 0.1 % F = ± 1.0 % Z = Jumper		CT C1		00 = Standard			
							8 = *10 ⁻² 9 = *10 ⁻¹ 0 = *10 ⁰ 1 = *10 ¹ 2 = *10 ² 3 = *10 ³ 4 = *10 ⁴ 5 = *10 ⁵ 6 = *10 ⁶ 0000 = Jumper										
PRODUCT DESCRIPTION: MBB/SMA 0207-50 1% VG06 CT 1K0																	
MBB/SMA 0207		-	50		1%		VG06		CT		1K0						
MODEL/SIZE			TCR		TOLERANCE		VG06 = CECC E7		PACKAGING (1)		RESISTANCE VALUE						
MBA/SMA 0204 MBB/SMA 0207 MBE/SMA 0414			15 ppm 50 ppm		± 0.1 % ± 1.0 %				CT C1		1K0 = 1 kΩ 51R1 = 51.1 Ω						

Note:

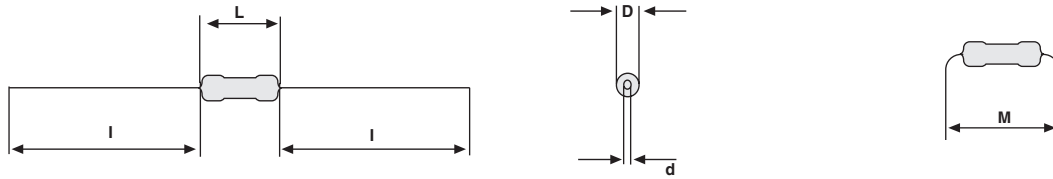
(1) Please refer to table PACKAGING for complete information.

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products.

EN 140101-806 ORDERING INFORMATION	
Example of the ordering information for a resistor:	MBA/SMA 0204-50 1% VG06 287K CECC40101-806EZAC287KFE7
Example of the ordering information for jumpers:	MBA/SMA 0204 VG06 0R0 CECC40101-806EZA-0R00-E7
The elements used in this ordering information have the following meaning:	
CECC40101-806	CECC Detail specification number
EZ	Assessment level
A	Style (see table Technical Specifications)
C	Temperature coefficient (C = ± 50 ppm/K; E = ± 15 ppm/K)
287K	Resistance value according to EN 60062, 4 characters
F	Tolerance on rated resistance (B = ± 0.1 %; F = ± 1 %)
E7	Failure rate level according to EN 60115-1, Table ZB.1

PACKAGING TABLE		
MODEL	BOX	
	PIECES	CODE
MBA/SMA 0204	1000	C1
	5000	CT
MBB/SMA 0207	1000	C1
	5000	CT
MBE/SMA 0414	1000	C1

DIMENSIONS



DIMENSIONS - leaded resistor types, mass and relevant physical dimensions						
TYPE	D _{max.} (mm)	L _{max.} (mm)	d _{nom.} (mm)	I _{min.} (mm)	M _{min.} (mm)	MASS (mg)
MBA/SMA 0204	1.6	3.6	0.5	29.0	5.0	125
MBB/SMA 0207	2.5	6.3	0.6	28.0	10.0	220
MBE/SMA 0414	4.0	11.9	0.8	31.0	15.0	700

Note:

- Color code marking is applied according to EN 60062 in five bands (E96 or E192 series). Each color band appears as a single solid line, voids are permissible if at least 2/3 of the band is visible from each radial angle of view. The last color band for tolerance is approximately 50 % wider than the other bands. An interrupted violet band between the 1st and 2nd full band indicates the failure rate level E7. An interrupted orange band between the 4th and 5th full band indicates the temperature coefficient of 15 ppm/K.

DESCRIPTION

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 (85 % Al₂O₃) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the metallised rods. A special laser is used to achieve the target value by smoothly cutting a helical groove in the resistive layer without damaging the ceramics. Connecting wires of electrolytic copper plated with 100 % pure tin are welded to the termination caps. The resistor elements are covered by a light blue protective coating designed for electrical, mechanical and climatic protection. Four or five color code rings designate the resistance value and tolerance in accordance with **EN 60062**.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are stuck directly on the adhesive tapes in accordance with **EN 60286-1**.

ASSEMBLY

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. Excellent solderability is proven, even after extended storage. They are suitable for automatic soldering using wave or dipping. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system. The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. The immunity of the plating against tin whisker growth has been proven under extensive testing.

All products comply with the CEFIC-EECA-EICTA list of legal restrictions on hazardous substances.

This includes full compliance with the following European RoHS directives:

- 2000/53/EC End of Vehicle Life Directive (ELV)
- 2000/53/EC Annex II to End of Vehicle Life Directive (ELV II)
- 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

Solderability is specified for 2 years after production or re-qualification. The permitted storage time is 20 years.



MBA/SMA 0204 VG06, MBB/SMA 0207 VG06, MBE/SMA 0414 VG06

Leaded Resistors with Established Reliability
(CECC 40101-806, Version E)

Vishay Beyschlag

APPROVALS

The resistors are tested in accordance with **CECC 40101-806** which refers to **EN 60115-1** and **EN 140400** and the variety of environmental test procedures of the **IEC/EN 60068** series. Approval of conformity is indicated by the **CECC** logo on the package label.

Vishay BEYSCHLAG has achieved “**Approval of Manufacturer**” in accordance with **EN 100114-1**. The release certificate for “**Technology Approval Schedule**” in accordance with **CECC 240 001** based on **EN 100114-6** is granted for the Vishay BEYSCHLAG manufacturing process.

SPECIALS

This product family of thin film leaded resistors with established reliability is complemented by **Zero Ohm Jumpers**.

FUNCTIONAL PERFORMANCE

Further information on the performance of these products may be found in the following datasheets:

- “Professional Leaded Resistors”
Document No. 28766
- “Precision Leaded Resistors”
Document No. 28767

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
DESCRIPTION		RESISTANCE VALUE ⁽¹⁾		
TCR	TOLERANCE	MBA/SMA 0204	MBB/SMA 0207	MBE/SMA 0414
± 50 ppm/K	± 1 %	1 Ω to 5.11 MΩ	1 Ω to 10 MΩ	1 Ω to 21.5 MΩ
± 15 ppm/K	± 0.1 %	100 Ω to 221 kΩ	100 Ω to 499 kΩ	100 Ω to 470 kΩ
Jumper	-	10 mΩ; I _{max.} = 3 A	10 mΩ; I _{max.} = 5 A	-

Note:

⁽¹⁾ Resistance values to be selected for ± 1 % tolerance from E96 only and for ± 0.1 % tolerance from E192 only

12NC INFORMATION

Resistance Decade

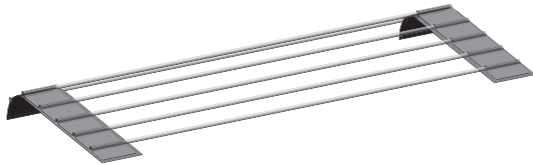
RESISTANCE DECADE	LAST DIGIT
1 Ω to 9.99 Ω	8
10 Ω to 99.9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9.99 kΩ	2
10 kΩ to 99.9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9.99 MΩ	5
10 MΩ to 99.9 MΩ	6

Ordering example (For historical coding reference of MBA 0204 VG06/MBB 0207 VG06/MBE 0414 VG06)

The Part Number of a MBA 0204 VG06 resistor, value 287K and TCR 50 with ± 1 % tolerance, supplied on bandolier in a box of 5000 units is: 2312 905 02874.

12NC CODE FOR HISTORICAL CODING REFERENCE OF MBA 0204 VG06/MBB 0207 VG06/MBE 0414 VG06				
DESCRIPTION			PART NUMBER 2312	
			BANDOLIER IN BOX	
TYPE	TCR	TOL.	C1 1000 UNITS	CT 5000 UNITS
MBA 0204 VG06	± 50 ppm/K	± 1 %	900 0....	905 0....
	± 15 ppm/K	± 0.1 %	902 0....	907 0....
	jumper	-	902 90001	907 90001
MBB 0207 VG06	± 50 ppm/K	± 1 %	910 0....	915 0....
	± 15 ppm/K	± 0.1 %	912 0....	917 0....
	jumper	-	912 90001	917 90001
MBE 0414 VG06	± 50 ppm/K	± 1 %	920 0....	-
	± 15 ppm/K	± 0.1 %	922 0....	

Jumper, Wire Bridges



FEATURES

- Suitable for automatic insertion
- Excellent soldering performance
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)

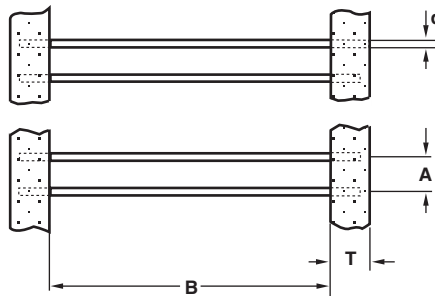


STANDARD ELECTRICAL SPECIFICATIONS		
MODEL	$I_{max.}$ A	$R_{max.}$ mΩ
DB1U	5	6.0
DB2U	8	4.5
DB4U	12	2.5

Note:

- Material: copper leads (E-Cu 58), tin solder finish

DIMENSIONS [in millimeters]



MODEL	B	T	d	A
DB1U	53 ± 1.5	6.0 ± 0.5	0.5	5.0 ± 0.5
DB2U	53 ± 1.5	6.0 ± 0.5	0.6	5.0 ± 0.5
DB4U	53 ± 1.5	6.0 ± 0.5	0.8	5.0 ± 0.5



PART NUMBER AND PRODUCT DESCRIPTION						
PART NUMBER: DB1U0000000000D000						
D	B	1	U	0	0	0
MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING	SPECIAL
DB1U000 DB2U000 DB4U000	0 = Neutral	0 = Neutral	4 digit value 0000	1 digit 0 = Neutral	D0 = R0 = 10 000 pieces on reel D5 = R5 = 5000 pieces on reel	00 = Standard
PRODUCT DESCRIPTION: DB1 U 0R0 R0						
DB1U		0R0		R0		
MODEL/SIZE		RESISTANCE VALUE		PACKAGING		
DB1U DB2U DB4U		0R0 = 0 Ω		R0 R5		

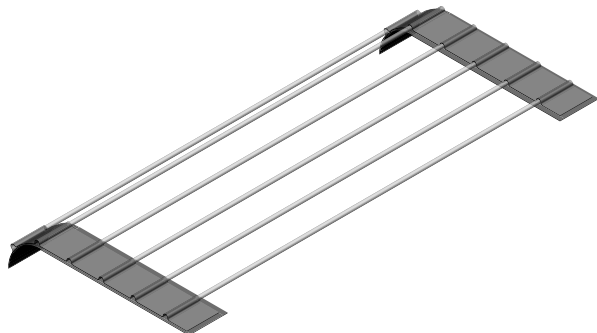
Note:

(1) Please refer to table PACKAGING for complete information.

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products.

PACKAGING	
TYPE	QUANTITY PER REEL
DB1U	10 000
DB2U	10 000
DB4U	5000

Wire Jumper



Wire Jumper is made of tinned copper wire, taped in ammo or reel packaging

FEATURES

- Available in two diameters
- Excellent solderability characteristics
- Different types of packaging and taping configurations available
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with “Restriction of the use of Hazardous Substances” (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- General industrial applications
- General equipment
- The wire jumpers are suitable for use on cutting and bending machines and automatic insertions machines

TECHNICAL SPECIFICATIONS		
DESCRIPTION	AXIAL TAPED	
	Ø 0.58 Cu	Ø 0.8 Cu
Resistance	< 0.006 Ω	
Pull-off Force	≥ 5 N	
Solderability	IEC 60115	
Maximum Current at 30 °C	7.0 A	10.0 A

12NC INFORMATION

- The wire jumpers have a 12-digit numeric code starting with 2306 101.
- The remaining last 5 digits indicate the packaging quantity for 2 different types of wire diameters.

12NC Example

The ordering code for a Ø 0.58 mm Cu wire jumper, supplied on bandolier of 5000 units in ammopack, is 2306 101 90169.

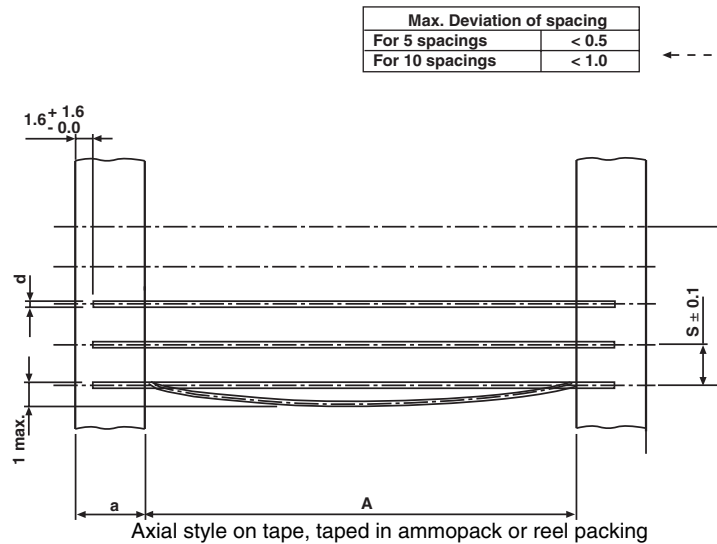
12NC - wire jumper type and packaging				
TYPE	Ø d (mm)	QUANTITY	PACKAGING METHOD	CODE
2306 101 90169	0.58	5000	Ammo box	A5
2306 101 90182	0.80	5000	Ammo box	A5
2306 101 90201	0.58	10 000	Ammo reel	R0
2306 101 90202	0.80	5000	Ammo reel	R5

PART NUMBER AND PRODUCT DESCRIPTION						
PART NUMBER: WIRE058000000A500						
W	I	R	E	0	5	8
0	0	0	0	0	0	0
0	0	0	0	A	5	0
0						
MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING ⁽¹⁾	SPECIAL
WIRE058 WIRE080	0 = Neutral	0 = Neutral	0000	0 = Neutral	A5 R5 R0	00 = Standard
PRODUCT DESCRIPTION: Wire Jumper 058 A5						
WIRE JUMPER 058			A5			
MODEL/SIZE			PACKAGING ⁽¹⁾			
WIRE058 WIRE080			A5 R5 R0			

Notes:

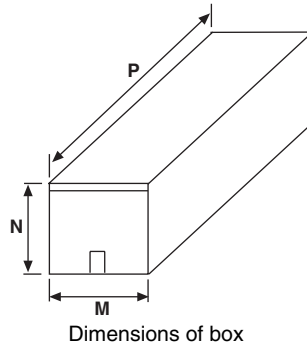
⁽¹⁾ Please refer to table 12NC - wire jumper type and packaging.

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products.

**DIMENSIONS
AXIAL TAPED**


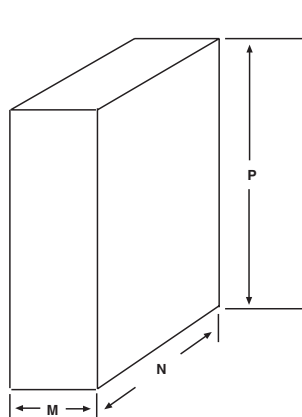
DIMENSIONS in millimeters - resistor type and relevant physical dimensions					
TYPE	A	Ø d	a	S	MASS PER 100 UNITS (g)
2306 101 90169	52.5 ± 1.5	0.58 ± 0.05 Cu	6 ± 0.5	5	14.0
2306 101 90201					
2306 101 90182		0.8 ± 0.03 Cu			24.9
2306 101 90202					

IN BOX

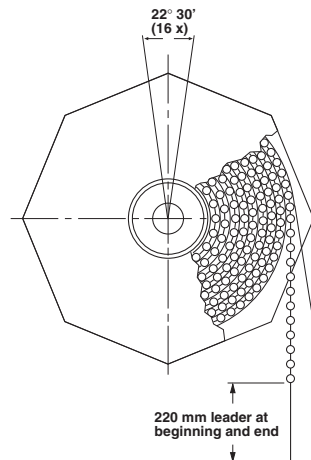


TYPE	QUANTITY	M	N	P
2306 101 90169	5000	78	98	270
2306 101 90182				

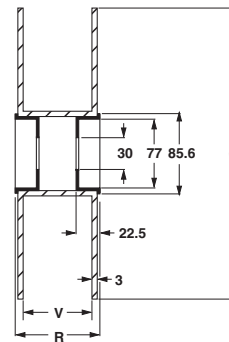
ON REEL



Dimensions of outer packaging
(for bandolier on reel)



Dimensions of inner packaging
(for bandolier on reel)



TYPE	QUANTITY	M	N	P	Q	V	R
2306 101 90201	10 000	92	310	310	305	75	86
2306 101 90202	5000						

TESTS AND REQUIREMENTS

Essentially all tests are carried out according to the schedule of IEC publications 251 and along the lines of IEC publication 68. "Recommended basic climatic and mechanical robustness testing procedure electronic components".

In some instances deviations from the IEC recommendation were necessary for our method of specification.

In the Test Procedures and Requirements table the tests are listed with reference to the relevant clauses of IEC publications 251 and 68; a short description is also given of the test procedure and requirements.

TEST PROCEDURES AND REQUIREMENTS				
IEC 152 CLAUSE	IEC 68 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
8	Ta	Soldering after aging 16 h at 155 ± 2 °C in air	Solderability: 2 s, 260 °C flux 600	good tinning, no damage
9	-	Dewetting after aging 16 h at 155 ± 2 °C in air	Solderability: 5 s 260 °C, flux 600	wetting < 95 % good tinning, no damage
6	-	Tensile Strength	Free length 200 to 250 mm rate 5 mm/s	Fm N/m ²
7	-	Elongation at break	Same as for clause 6	15 % to 25 % elongation

Metal Film Resistors, Industrial, Zero Ohm Jumper Resistor



FEATURES

- Provides low resistance circuit interconnections
- Color band marking for ease of identification after mounting
- Flame retardant coating
- Compatible with automatic insertion equipment
- Tape and reel packaging
- Lead (Pb)-free version is RoHS compliant



RoHS*
COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS

GLOBAL MODEL	HISTORICAL MODEL	MAXIMUM RESISTANCE VALUE mΩ	MAXIMUM CURRENT A	
			AT + 25 °C	AT + 150 °C
FRJ50	FRJ-50	10	25	0

TECHNICAL SPECIFICATIONS

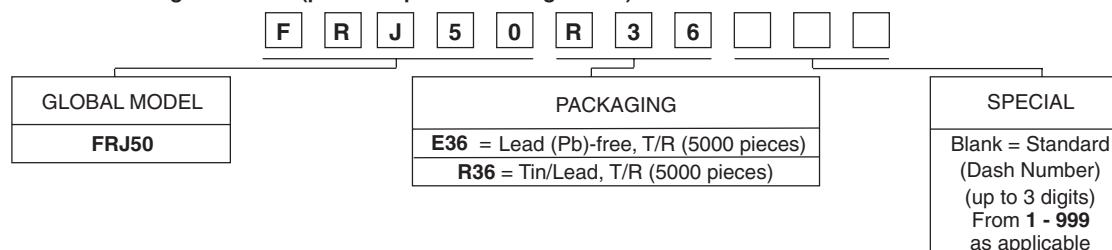
PARAMETER	UNIT	FRJ50
Insulation Resistance - Dry	MΩ	10 000
Insulation Resistance - Wet	MΩ	100
Category Temperature Range	°C	- 55/+ 155
Dielectric Strength	- Atmospheric - Reduced	V_{RMS} 500 V_{RMS} 325
Failure Rate	$10^{-9}/h$	< 10
Weight	g	0.1

MATERIAL SPECIFICATIONS

Insulation Flammability:	Self extinguishing 10 s after flame is removed	Solder plated copper:	Tin-plated copper or Tin/Lead plated copper
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GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: FRJ50R36 (preferred part numbering format)

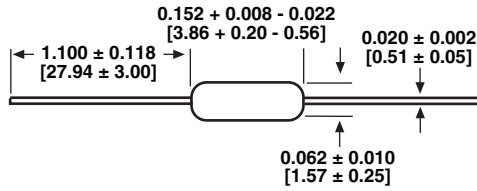
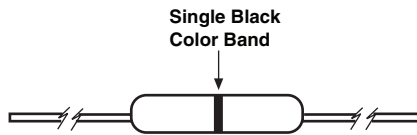


Historical Part Number example: FRJ-50 R36 (will continue to be accepted)



* Pb containing terminations are not RoHS compliant, exemptions may apply

DIMENSIONS in inches [millimeters]

FRJ50

MARKING

PACKAGING

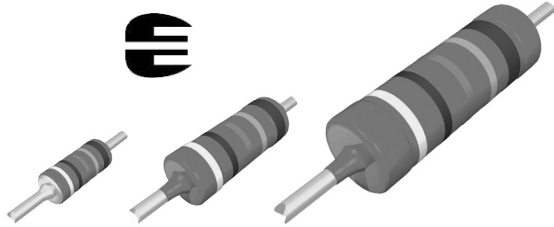
Taped Lead and Reel Package

(52.4 mm inside tape spacing per EIA-296-E)

Notes:

- Quantity per reel: 5000 pieces in 5000-piece increments
- A minimum of 12.0" [305 mm] bare tape leader shall be provided at each end of the reel
- Paper separator protection between layers of components
- Reel arbor hole is 1.25" [31.75 mm]

Precision Leaded Resistors



DESCRIPTION

MBA/SMA 0204, MBB/SMA 0207 and MBE/SMA 0414 precision leaded thin film resistors combine the proven reliability of the professional products with an advanced level of precision and stability. Therefore they are perfectly suited for applications in the fields of test and measuring equipment along with industrial and medical electronics.

FEATURES

- Approved according to CECC 40101-806
- Advanced thin film technology
- Low TCR: ± 15 to ± 25 ppm/K
- Precision tolerance of value: $\pm 0.1\%$ and $\pm 0.25\%$
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- Superior overall stability: Class 0.05
- Wide precision range: $10\ \Omega$ to $1.5\ M\Omega$



APPLICATIONS

- Test and measuring equipment
- Industrial electronics
- Medical electronics

METRIC SIZE

DIN:	0204	0207	0414
CECC:	A	B	D

TECHNICAL SPECIFICATIONS

DESCRIPTION	MBA/SMA 0204		MBB/SMA 0207		MBE/SMA 0414	
CECC Size	A		B		D	
Resistance Range	22 Ω to 332 k Ω		10 Ω to 1 M Ω		22 Ω to 1.5 M Ω	
Resistance Tolerance	$\pm 0.25\%$; $\pm 0.1\%$					
Temperature Coefficient	± 25 ppm/K; ± 15 ppm/K					
Operation Mode	precision	standard	precision	standard	precision	standard
Climatic Category (LCT/UCT/Days)	10/85/56	55/125/56	10/85/56	55/125/56	10/85/56	55/125/56
Rated Dissipation, P_{70}	0.07 W	0.25 W	0.11 W	0.40 W	0.17 W	0.65 W
Operating Voltage, U_{max} . AC/DC	200 V		350 V		500 V	
Film Temperature	85 $^{\circ}$ C	125 $^{\circ}$ C	85 $^{\circ}$ C	125 $^{\circ}$ C	85 $^{\circ}$ C	125 $^{\circ}$ C
Max. Resistance Change at P_{70} for Resistance Range, $\Delta R/R$ max., After:	100 Ω to 100 k Ω		100 Ω to 270 k Ω		100 Ω to 470 k Ω	
1000 h	$\leq 0.05\%$	$\leq 0.25\%$	$\leq 0.05\%$	$\leq 0.25\%$	$\leq 0.05\%$	$\leq 0.25\%$
8000 h	$\leq 0.1\%$	$\leq 0.5\%$	$\leq 0.1\%$	$\leq 0.5\%$	$\leq 0.1\%$	$\leq 0.5\%$
225 000 h	$\leq 0.3\%$	$\leq 1.5\%$	$\leq 0.3\%$	$\leq 1.5\%$	$\leq 0.3\%$	$\leq 1.5\%$
Specified Lifetime	225 000 h		225 000 h		225 000 h	
Permissible Voltage Against Ambient (Insulation):						
1 Min; U_{ins}	300 V		500 V		800 V	
Continuous	75 V		75 V		75 V	
Failure Rate	$\leq 0.7 \times 10^{-9}/h$		$\leq 0.3 \times 10^{-9}/h$		$\leq 0.1 \times 10^{-9}/h$	

Note:

MB_ series has been merged with the related SMA series to form one series "MB_/SMA_".



MBA/SMA 0204, MBB/SMA 0207, MBE/SMA 0414 - Precision

Precision Leaded Resistors

Vishay Beyschlag

PART NUMBER AND PRODUCT DESCRIPTION																	
PART NUMBER: MBB02070D1001BCT00																	
M	B	B	0	2	0	7	0	D	1	0	0	1	B	C	T	0	0
MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE		TOLERANCE	PACKAGING (1)	SPECIAL										
MBA0204 = MBA/SMA 0204 MBB0207 = MBB/SMA 0207 MBE0414 = MBE/SMA 0414	0 = Neutral N = RB Radial 5 mm S = UB Radial 2.5 mm	E = ± 15 ppm/K D = ± 25 ppm/K	3 digit value 1 digit multiplier MULTIPLIER 8 = *10 ⁻² 2 = *10 ² 9 = *10 ⁻¹ 3 = *10 ³ 0 = *10 ⁰ 4 = *10 ⁴ 1 = *10 ¹ 5 = *10 ⁵		B = ± 0.1 % C = ± 0.25 %	CT C1 RP R1 R2 R4 N4	00 = Standard										
PRODUCT DESCRIPTION: MBB/SMA 0207-25 0.1 % CT 1K0																	
MBB/SMA 0207	-	25	0.1 %	CT	1K0												
MODEL/SIZE		TCR	TOLERANCE	PACKAGING (1)	RESISTANCE												
MBA/SMA 0204 MBB/SMA 0207 MBE/SMA 0414		± 15 ppm/K ± 25 ppm/K	± 0.1 % ± 0.25 %	CT C1 RP R1 R2 R4 N4	1K0 = 1 kΩ 51R1 = 51.1 Ω												

Notes:

(1) Please refer to table PACKAGING for complete information.

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products.

PACKAGING				
MODEL	REEL		BOX	
	PIECES	CODE	PIECES	CODE
MBA/SMA 0204	1000 5000	R1 RP	1000 5000	C1 CT
MBB/SMA 0207	1000 4000 5000	R1 R4 (for RB, UB) RP	1000 4000 5000	C1 N4 (for RB, UB) CT
MBE/SMA 0414	2500	R2	1000	C1

12NC CODE FOR HISTORICAL CODING REFERENCE OF MBA 0204/MBB 0207/MBE 0414							
DESCRIPTION			ORDERING CODE 2312 (BANDOLIER)				
			AMMOPACK		REEL		
TYPE	TCR	TOL.	C1 1000 units	CT 5000 units	R1 1000 units	R2 2500 units	RP 5000 units
MBA 0204	± 25 ppm/K	± 0.25 %	901 6....	906 6....	701 6....	-	806 6....
		± 0.1 %	901 7....	906 7....	701 7....	-	806 7....
	± 15 ppm/K	± 0.25 %	902 6....	907 6....	702 6....	-	807 6....
		± 0.1 %	902 7....	907 7....	702 7....	-	807 7....
MBB 0207	± 25 ppm/K	± 0.25 %	911 6....	916 6....	711 6....	-	816 6....
		± 0.1 %	911 7....	916 7....	711 7....	-	816 7....
	± 15 ppm/K	± 0.25 %	912 6....	917 6....	712 6....	-	817 6....
		± 0.1 %	912 7....	917 7....	712 7....	-	817 7....
MBE 0414	± 25 ppm/K	± 0.25 %	921 6....	-	-	826 6....	-
		± 0.1 %	921 7....	-	-	826 7....	-
	± 15 ppm/K	± 0.25 %	922 6....	-	-	827 6....	-
		± 0.1 %	922 7....	-	-	827 7....	-

12NC INFORMATION

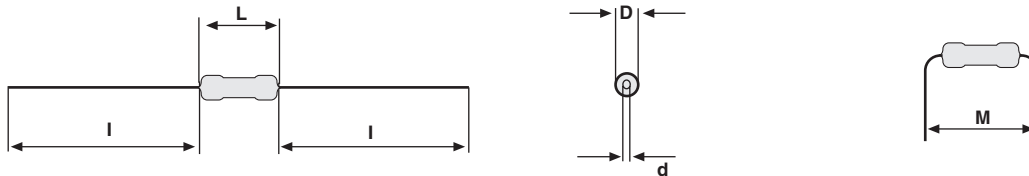
Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
10 Ω to 99.9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9.99 kΩ	2
10 kΩ to 99.9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9.99 MΩ	5

12NC Example (For Historical coding reference of MBA 0204/MBB 0207/MBE 0414)

The 12NC code of a MBA 0204 resistor, value 47 kΩ and TCR 25 with ± 0.1 % tolerance, supplied on bandolier in a box of 5000 units is: 2312 906 74703.

DIMENSIONS



DIMENSIONS - leaded resistor types, mass and relevant physical dimensions						
TYPE	D _{max.} (mm)	L _{max.} (mm)	d _{nom.} (mm)	l _{min.} (mm)	M _{min.} (mm)	MASS (mg)
MBA/SMA 0204	1.6	3.6	0.5	29.0	5.0	125
MBB/SMA 0207	2.5	6.3	0.6	28.0	10.0 ⁽¹⁾	220
MBE/SMA 0414	4.0	11.9	0.8	31.0	15.0	700

Note:

⁽¹⁾ For 7.5 ≤ M < 10.0 mm, use version MBB/SMA 0207 ... L0 without lacquer on the leads.

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
DESCRIPTION		RESISTANCE VALUE ⁽²⁾		
TCR	TOLERANCE	MBA/SMA 0204	MBB/SMA 0207	MBE/SMA 0414
± 25 ppm/K	± 0.25 %	22 Ω to 332 kΩ	10 Ω to 1 MΩ	22 Ω to 1.5 MΩ
	± 0.1 %	43 Ω to 332 kΩ	10 Ω to 1 MΩ	43 Ω to 1 MΩ
± 15 ppm/K	± 0.25 %	22 Ω to 221 kΩ	10 Ω to 1 MΩ	22 Ω to 1 MΩ
	± 0.1 %	43 Ω to 221 kΩ	10 Ω to 1 MΩ	43 Ω to 1 MΩ

Notes:

- ⁽²⁾ Resistance values to be selected from E96 and E192 series, for other values please contact factory.
- Resistance ranges printed in bold are preferred TCR/tolerance combinations with optimized availability.



DESCRIPTION

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 (85 % Al2O3) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the metallized rods. A special laser is used to achieve the target value by smoothly cutting a helical groove in the resistive layer without damaging the ceramics. A further conditioning is applied in order to stabilise the trimming result. Connecting wires of electrolytic copper plated with 100 pure tin are welded to the termination caps. The resistors are covered by protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating. Four or five color code rings designate the resistance value and tolerance in accordance with IEC 60062.

The result of the determined production is verified by an extensive testing procedure performed on 100 of the individual resistors. Only accepted products are stuck directly on the adhesive tapes in accordance with IEC 60286-1.

ASSEMBLY

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. Excellent solderability is proven, even after extended storage. They are suitable for automatic soldering using wave or dipping. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. The immunity of the plating against tin whisker growth has been proven under extensive testing. All products comply with the CEFIC-EECA-EICTA list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

- 2000/53/EC End of Vehicle Life Directive (ELV)
• 2000/53/EC Annex II to End of Vehicle Life Directive (ELV II)
• 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
• 2002/96/EC Waste Electrical and Electrical Equipment Directive (WEEE)

APPROVALS

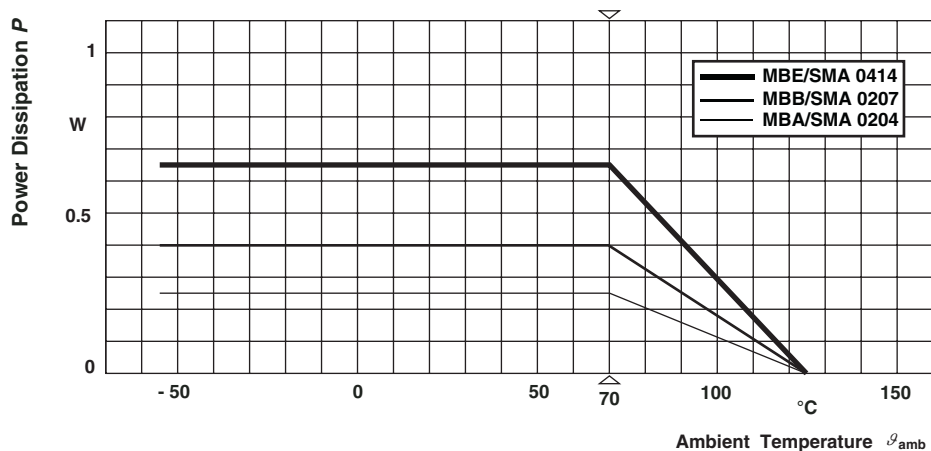
Where applicable, the resistors are tested in accordance with CECC 40101-806 which refers to EN 60115-1 and EN 140100. Approval of conformity is indicated by the CECC logo on the package label.

Vishay BEYSCHLAG has achieved "Approval of Manufacturer" in accordance with EN 100114-1.

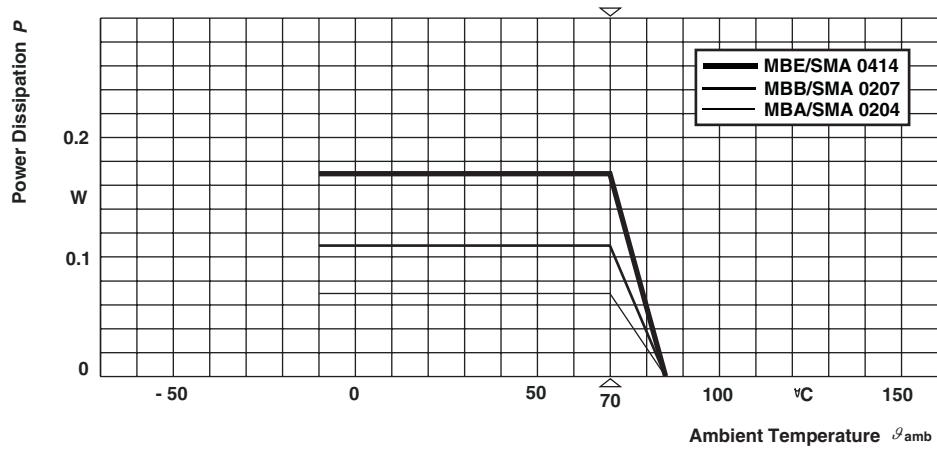
SPECIALS

On request, resistors are available with established reliability in accordance with CECC 40101-806 Version E. Please refer to the special datasheet for information on failure rate level, available resistance ranges and ordering codes.

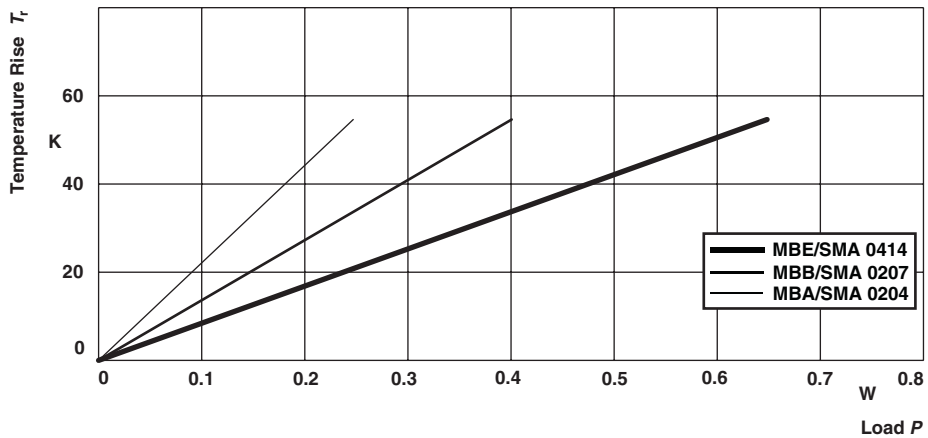
FUNCTIONAL PERFORMANCE



Derating - Long Term Operation

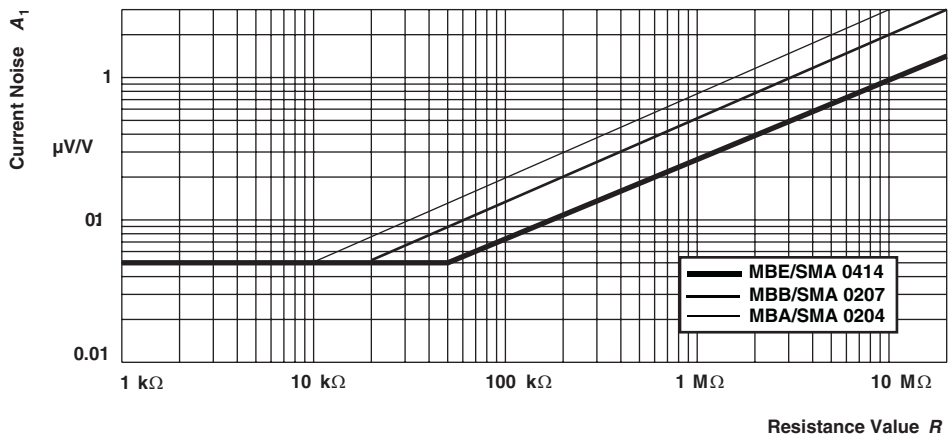


Derating - Precision Operation



Rise of the surface temperature.

Temperature Rise



Current Noise A_1 In Accordance With IEC 60195



TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the following specifications:

EN 140000/IEC 60115-1, Generic specification (includes tests)

EN 140100/IEC 60115-2, Sectional specification (includes schedule for qualification approval)

CECC 40101-806, Detail specification (includes schedule for conformance inspection)

Most of the components are approved in accordance with the European CECC-system, where applicable. The Test Procedures and Requirements table contains only the most important tests. For the full test schedule refer to the documents listed above. The testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5202.

The tests are carried out in accordance with IEC 60068 and under standard atmospheric conditions in accordance with

IEC 60068-1, 5.3. Climatic category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days) is valid.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 45 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

For testing the components are mounted on a test board in accordance with IEC 60115-1, 4.31 unless otherwise specified.

In the Test Procedures and Requirements table, only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60 068-2; a short description of the test procedure is also given.

TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR max.)		
			stability for product types:	STABILITY CLASS 0.05	STABILITY CLASS 0.1	STABILITY CLASS 0.25
			MBA/SMA 0204	100 Ω to 100 k Ω	43 Ω to < 100 Ω ; > 100 k Ω to 221 k Ω	22 Ω to < 43 Ω ; > 221 k Ω to 332 k Ω
			MBB/SMA 0207	100 Ω to 270 k Ω	43 Ω to < 100 Ω ; > 270 k Ω to 510 k Ω	10 Ω to < 43 Ω ; > 510 k Ω to 1 M Ω
			MBE/SMA 0414	100 Ω to 470 k Ω	43 Ω to <100 Ω ; > 470 k Ω to 1 M Ω	22 Ω to < 43 Ω ; > 1 M Ω to 1.5 M Ω
4.5	-	resistance	-	$\pm 0.25\%$; $\pm 0.1\%$		
4.8.4.2	-	temperature coefficient	at 20/LCT/20 °C and 20/UCT/20 °C	± 25 ppm/K; ± 15 ppm/K		
4.25.1	-	endurance at 70 °C: precision operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h ON; 0.5 h OFF			
			70 °C; 1000 h	$\pm (0.05\% R + 0.01 \Omega)^{(1)}$	$\pm (0.1\% R + 0.01 \Omega)$	$\pm (0.25\% R + 0.05 \Omega)^{(2)}$
			70 °C; 8000 h	$\pm (0.1\% R + 0.01 \Omega)$	$\pm (0.2\% R + 0.01 \Omega)$	$\pm (0.5\% R + 0.05 \Omega)$
		endurance at 70 °C: standard operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h ON; 0.5 h OFF			



TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR max.)		
			stability for product types:	STABILITY CLASS 0.05	STABILITY CLASS 0.1	STABILITY CLASS 0.25
			MBA/SMA 0204	100 Ω to 100 k Ω	43 Ω to < 100 Ω ; > 100 k Ω to 221 k Ω	22 Ω to < 43 Ω ; > 221 k Ω to 332 k Ω
			MBB/SMA 0207	100 Ω to 270 k Ω	43 Ω to < 100 Ω ; > 270 k Ω to 510 k Ω	10 Ω to < 43 Ω ; > 510 k Ω to 1 M Ω
			MBE/SMA 0414	100 Ω to 470 k Ω	43 Ω to <100 Ω ; > 470 k Ω to 1 M Ω	22 Ω to < 43 Ω ; > 1 M Ω to 1.5 M Ω
4.24	78 (Cab)	damp heat, steady state	(40 \pm 2) $^{\circ}$ C; 56 days; (93 \pm 3) % RH	\pm (0.05 % R + 0.01 Ω)	\pm (0.1 % R + 0.01 Ω)	\pm (0.25 % R + 0.05 Ω)
4.23		climatic sequence:				
4.23.2	2 (Ba)	dry heat	125 $^{\circ}$ C; 16 h			
4.23.3	30 (Db)	damp heat, cyclic	55 $^{\circ}$ C; 24 h; 90 % to 100 % RH; 1 cycle			
4.23.4	1 (Aa)	cold	- 55 $^{\circ}$ C; 2 h			
4.23.5	13 (M)	low air pressure	8.5 kPa; 2 h; 15 $^{\circ}$ C to 35 $^{\circ}$ C			
4.23.6	30 (Db)	damp heat, cyclic	55 $^{\circ}$ C; 5 days; 95 % to 100 % RH; 5 cycles	\pm (0.05 % R + 0.01 Ω) no visible damage	\pm (0.1 % R + 0.01 Ω) no visible damage	\pm (0.25 % R + 0.05 Ω) no visible damage
4.13	-	short time overload	room temperature; $U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; 5 s	\pm (0.01 % R + 0.01 Ω) no visible damage	\pm (0.02 % R + 0.01 Ω) no visible damage	\pm (0.05 % R + 0.01 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 min at LCT and 30 min at UCT; 5 cycles	\pm (0.01 % R + 0.01 Ω) no visible damage	\pm (0.02 % R + 0.01 Ω) no visible damage	\pm (0.05 % R + 0.01 Ω) no visible damage



TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR max.)		
			stability for product types:	STABILITY CLASS 0.05	STABILITY CLASS 0.1	STABILITY CLASS 0.25
			MBA/SMA 0204	100 Ω to 100 k Ω	43 Ω to < 100 Ω ; > 100 k Ω to 221 k Ω	22 Ω to < 43 Ω ; > 221 k Ω to 332 k Ω
			MBB/SMA 0207	100 Ω to 270 k Ω	43 Ω to < 100 Ω ; > 270 k Ω to 510 k Ω	10 Ω to < 43 Ω ; > 510 k Ω to 1 M Ω
			MBE/SMA 0414	100 Ω to 470 k Ω	43 Ω to < 100 Ω ; > 470 k Ω to 1 M Ω	22 Ω to < 43 Ω ; > 1 M Ω to 1.5 M Ω
4.29	45 (XA)	component solvent resistance	isopropyl alcohol + 23 °C; toothbrush method	marking legible; no visible damage		
4.18.2	20 (Tb)	resistance to soldering heat	unmounted components; (260 \pm 5) °C; (10 \pm 1) s	\pm (0.01 % R + 0.01 Ω) no visible damage	\pm (0.02 % R + 0.01 Ω) no visible damage	\pm (0.05 % R + 0.01 Ω) no visible damage
4.17	20 (Ta)	solderability	+ 235 °C; 2 s solder bath method	good tinning (\geq 95 % covered, no visible damage)		
4.22	6 (B4)	vibration	6 h; 10 Hz to 2000 Hz 1.5 mm or 196 m/s ²	\pm (0.01 % R + 0.01 Ω)	\pm (0.02 % R + 0.01 Ω)	\pm (0.05 % R + 0.01 Ω)
4.16	21 (Ua ₁) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	\pm (0.01 % R + 0.01 Ω)	\pm (0.02 % R + 0.01 Ω)	\pm (0.05 % R + 0.01 Ω)
4.7	-	voltage proof	$U_{RMS} = U_{ins}$; 60 s	no flashover or breakdown		
4.25.3	-	endurance at upper category temperature	85 °C; 1000 h 125 °C; 1000 h	- \pm (0.05 % R + 0.01 Ω)	- \pm (0.1 % R + 0.01 Ω)	- \pm (0.25 % R + 0.05 Ω)

Notes:

(1) \pm (0.03 % R + 0.01 Ω) for MBB/SMA 0207

(2) \pm (0.15 % R + 0.05 Ω) for MBB/SMA 0207

High Precision Leaded Resistors



DESCRIPTION

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 coated with lacquer which provides electrical, mechanical, and climatic protection.

FEATURES

- High precision resistors (TCR up to ± 5 ppm/K, 0.01 % tol.)
- High stability (0.05 %)
- Low temperature coefficient (up to ± 5 ppm/K)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- Test and measurement
- Telecom

TECHNICAL SPECIFICATIONS		
DESCRIPTION	MPR24	
CECC Size, DIN Size	B, 0207	
Resistance Range	10 Ω to 1 M Ω	
Resistance Tolerance	± 0.05 %; ± 0.02 %; ± 0.01 %	± 0.5 %; ± 0.25 %; ± 0.1 %
Temperature Coefficient	± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K; ± 05 ppm/K	
Climatic Category (LCT/UCT/Days)	55/125/56	55/155/56
Max. Rated Dissipation, P_{70}	0.125 W	0.25 W
Operating Voltage, U_{max} . AC/DC	250 V	
Film Temperature	125 $^{\circ}$ C	155 $^{\circ}$ C
Max. Resistance Change for Resistance Range, ΔR max., After:		
Load	$\pm (0.05$ % $R + 0.01$ $\Omega)$	
Climatic Tests	$\pm (0.05$ % $R + 0.01$ $\Omega)$	
Soldering	$\pm (0.01$ % $R + 0.01$ $\Omega)$	
Short Time Overload	$\pm (0.01$ % $R + 0.01$ $\Omega)$	
Permissible Voltage Against Ambient :		
1 Min; U_{ins}	500 V	
Continuous	75 V	
Failure Rate	$\leq 0.3 \times 10^{-9}$ /h	



12NC INFORMATION

Components may be ordered by using either a simple clear text ordering code, see “Type Description and Ordering Code” or Vishay BCcomponents’ unique 12NC.

- The resistors have a 12-digit numeric code starting with 2322 14.
- The subsequent 3 digits indicate the resistor type, specification and packaging; see the 12NC table.

- The remaining 3 digits indicate the resistance value. The number is available upon request and is fixed by the supplier.

12NC Example

The 12NC of an MPR24 resistor with tolerance of $\pm 0.02\%$ and TCR ± 05 ppm/K, taped on bandolier in box of 100 units starts with 2322 141 77...; the last 3 digits are available upon request and are fixed by the supplier.

12NC - resistor type and packaging					
DESCRIPTION			ORDERING CODE 2322 14.		
			BANDOLIER IN BOX	BANDOLIER IN BOX	BANDOLIER ON REEL
TYPE	TCR	TOL.	100 units	1000 units	5000 units
MPR24	± 25 ppm/K	$\pm 0.5\%$	1 00...	1 10...	3 10...
		$\pm 0.25\%$	1 20...	1 30...	3 30...
		$\pm 0.1\%$	1 40...	1 50...	3 50...
		$\pm 0.05\%$	1 64...	3 64...	-
		$\pm 0.02\%$	1 74...	3 74...	-
		$\pm 0.01\%$	1 84...	3 84...	-
	± 15 ppm/K	$\pm 0.5\%$	1 05...	1 15...	3 15...
		$\pm 0.25\%$	1 25...	1 35...	3 35...
		$\pm 0.1\%$	1 45...	1 55...	3 55...
		$\pm 0.05\%$	1 65...	3 65...	-
		$\pm 0.02\%$	1 75...	3 75...	-
		$\pm 0.01\%$	1 85...	3 85...	-
	± 10 ppm/K	$\pm 0.5\%$	1 06...	1 16...	3 16...
		$\pm 0.25\%$	1 26...	1 36...	3 36...
		$\pm 0.1\%$	1 46...	1 56...	3 56...
		$\pm 0.05\%$	1 66...	3 66...	-
		$\pm 0.02\%$	1 76...	3 76...	-
		$\pm 0.01\%$	1 86...	3 86...	-
	± 5 ppm/K	$\pm 0.5\%$	1 07...	1 17...	3 17...
		$\pm 0.25\%$	1 27...	1 37...	3 37...
		$\pm 0.1\%$	1 47...	1 57...	3 57...
		$\pm 0.05\%$	1 67...	3 67...	-
		$\pm 0.02\%$	1 77...	3 77...	-
		$\pm 0.01\%$	1 87...	3 87...	-

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER: MPR24000E1001DC100

M	P	R	2	4	0	0	0	E	1	0	0	1	D	C	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MODEL/SIZE MPR2400	SPECIAL CHARACTER 0 = Neutral	TCR Z = ± 5 ppm/K Y = ± 10 ppm/K X = ± 15 ppm/K E = ± 25 ppm/K	VALUE 3 digit value 1 digit multiplier MULTIPLIER 9 = *10 ⁻¹ 2 = *10 ² 0 = *10 ⁰ 3 = *10 ³ 1 = *10 ¹ 4 = *10 ⁴	TOLERANCE T = ± 0.01 % H = ± 0.02 % A = ± 0.05 % B = ± 0.1 % C = ± 0.25 % D = ± 0.5 %	PACKAGING (1) RP CU C1	SPECIAL Up to 2 digits 00 = Standard
------------------------------	---	---	---	--	--	---

PRODUCT DESCRIPTION: MPR24 - 25 0.5 % C1 1K0

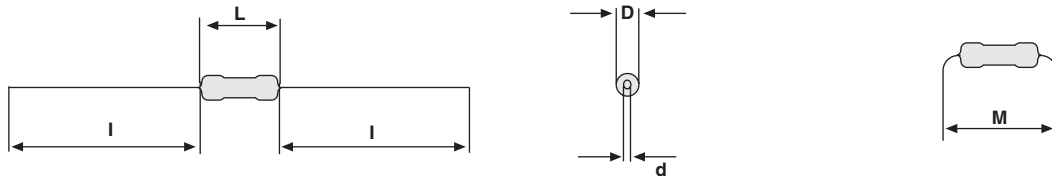
MPR24 MODEL/SIZE MPR24	25 TCR Z = 5 ppm Y = 10 ppm X = 15 ppm E = 25 ppm	0.5 % TOLERANCE ± 0.01 % ± 0.02 % ± 0.05 % ± 0.1 % ± 0.25 % ± 0.5 %	C1 PACKAGING (1) RP CU C1	1K0 RESISTANCE VALUE 1K0 = 1 kΩ 50R5 = 50.5 Ω
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Notes:

(1) Please refer to table PACKAGING for complete information

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

DIMENSIONS



DIMENSIONS - leaded resistor types, mass and relevant physical dimensions

TYPE	D _{max.} (mm)	L _{max.} (mm)	d _{nom.} (mm)	I _{min.} (mm)	M _{min.} (mm)	MASS (mg)
MPR 24	2.5	6.3	0.6	28.0	7.5	220

SCRIPT MARKING (2)

TEMPERATURE COEFFICIENT AND TOLERANCE - printed resistance value and letter coding

RESISTANCE VALUE	TOL. (%)	LETTER CODE	TCR (ppm/K)	LETTER CODE
Clear text code for value	± 0.5	D	± 25	E
	± 0.25	C	± 15	F
	± 0.1	B	± 10	B
	± 0.05	A	± 05	A
	± 0.02	P	-	-
	± 0.01	T	-	-

Note:

(2) Resistors of TCR ± 25 ppm/K in combination with tolerances ± 0.5 %, ± 0.25 % and ± 0.1 % are only available with color coding in accordance with IEC 60062.



TEMPERATURE COEFFICIENT AND RESISTANCE RANGE		
DESCRIPTION		RESISTANCE VALUE ⁽²⁾
TCR ⁽¹⁾	TOLERANCE	MPR24
± 25 ppm/K	± 0.5 %	10 Ω to 1 MΩ
	± 0.25 %	10 Ω to 1 MΩ
	± 0.1 %	10 Ω to 1 MΩ
	± 0.05 %	24 Ω to 100 kΩ
	± 0.02 %	24 Ω to 100 kΩ
	± 0.01 %	24 Ω to 100 kΩ
± 15 ppm/K	± 0.5 %	10 Ω to 1 MΩ
	± 0.25 %	10 Ω to 1 MΩ
	± 0.1 %	10 Ω to 1 MΩ
	± 0.05 %	24 Ω to 100 kΩ
	± 0.02 %	24 Ω to 100 kΩ
	± 0.01 %	24 Ω to 100 kΩ
± 10 ppm/K	± 0.5 %	10 Ω to 1 MΩ
	± 0.25 %	10 Ω to 1 MΩ
	± 0.1 %	10 Ω to 1 MΩ
	± 0.05 %	24 Ω to 100 kΩ
	± 0.02 %	24 Ω to 100 kΩ
	± 0.01 %	24 Ω to 100 kΩ
± 5 ppm/K	± 0.5 %	10 Ω to 1 MΩ
	± 0.25 %	10 Ω to 1 MΩ
	± 0.1 %	10 Ω to 1 MΩ
	± 0.05 %	24 Ω to 100 kΩ
	± 0.02 %	24 Ω to 100 kΩ
	± 0.01 %	24 Ω to 100 kΩ

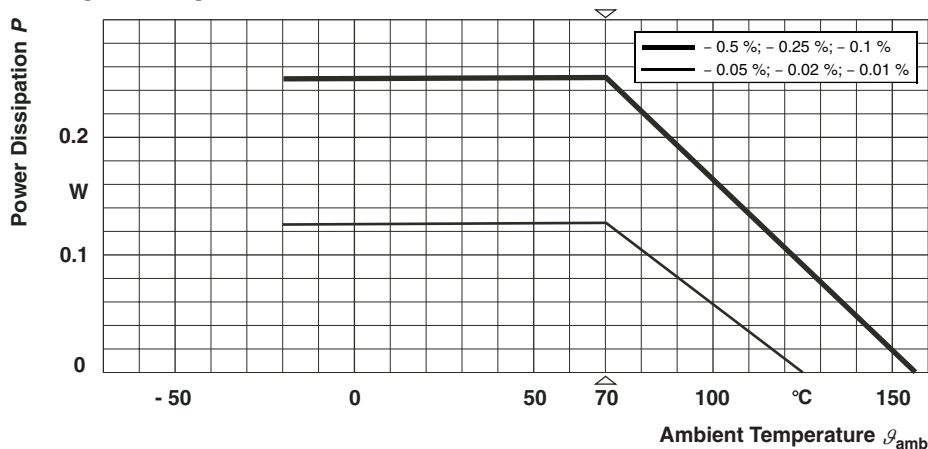
Notes:

(1) The temperature coefficient is specified over the temperature range + 20 °C to + 70 °C.

(2) Resistance values to be selected from E192 series, for other values please contact the factory.

PACKAGING				
MODEL	REEL		BOX	
	PIECES/REEL	CODE	PIECES/BOX	CODE
MPR24	5000	RP	100 1000	CU C1

FUNCTIONAL PERFORMANCE



Derating - Depending on Resistance Tolerances



TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the following specifications:

EN 140000/IEC 60115-1, Generic specification (includes tests)

EN 140100/IEC 60115-2, Sectional specification (includes schedule for qualification approval)

CECC 40101-806, Detail specification (includes schedule for conformance inspection)

Most of the components are approved in accordance with the European CECC-system, where applicable. The following table contains only the most important tests. For the full test schedule refer to the documents listed above. The testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5202.

The tests are carried out in accordance with IEC 60 068 and under standard atmospheric conditions in accordance with

IEC 60068-1, 5.3. Climatic category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days) is valid.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 45 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

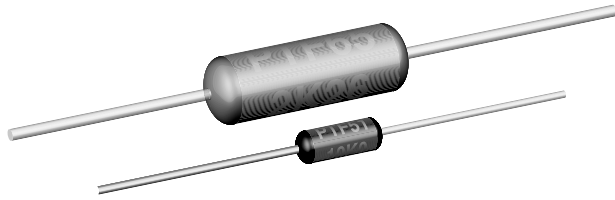
For testing the components are mounted on a test board in accordance with IEC 60115-1, 4.31 unless otherwise specified.

In the Test Procedures and Requirements table only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2; a short description of the test procedure is also given.

TEST PROCEDURES AND REQUIREMENTS					
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)	
			Stability for product types:	24 Ω to 100 k Ω	4.99 Ω to < 24 Ω ; > 100 k Ω to 1 M Ω
4.5	-	resistance ($\Delta R/R$)	-	$\pm 0.5\%$; $\pm 0.25\%$; $\pm 0.1\%$; $\pm 0.05\%$; $\pm 0.02\%$; $\pm 0.01\%$	$\pm 0.5\%$; $\pm 0.25\%$; $\pm 0.1\%$
4.8.4.2	-	temperature coefficient	at 20/70/20 °C	± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K; ± 05 ppm/K	
			at 20/LCT/20 °C and 20/UCT/20 °C	± 25 ppm/K	
4.25.1	-	endurance at 70 °C	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h ON; 0.5 h OFF 70 °C; 2000 h	$\pm (0.05\% R + 0.01 \Omega)$	
4.24	78 (Cab)	damp heat, steady state	(40 \pm 2) °C; 56 days; (93 \pm 3) % RH	$\pm (0.05\% R + 0.01 \Omega)$	
4.23	2 (Ba) 30 (Db)	climatic sequence:			
4.23.2		dry heat	125 °C; 16 h		
4.23.3		damp heat, cyclic	55 °C; 24 h; 90 % to 100 % RH; 1 cycle		

TEST PROCEDURES AND REQUIREMENTS					
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)	
			Stability for product types:	24 Ω to 100 k Ω	4.99 Ω to < 24 Ω ; > 100 k Ω to 1 M Ω
4.23.4 4.23.5 4.23.6	1 (Aa) 13 (M) 30 (Db)	cold low air pressure damp heat, cyclic	- 55 °C; 2 h 8.5 kPa; 2 h; 15 °C to 35 °C 55 °C; 5 days; 95 % to 100 % RH; 5 cycles	$\pm (0.05 \% R + 0.01 \Omega)$ no visible damage	
4.13	-	short time overload	Room temperature; $U = 2.5 \times \sqrt{P_{70}} \times R$ or $U = 2 \times U_{max.}$; 5 s	$\pm (0.01 \% R + 0.01 \Omega)$ no visible damage	
4.19	14 (Na)	rapid change of temperature	30 min at LCT and 30 min at UCT; 5 cycles	$\pm (0.01 \% R + 0.01 \Omega)$ no visible damage	
4.29	45 (XA)	component solvent resistance	Isopropyl alcohol + 23 °C; toothbrush method	marking legible; no visible damage	
4.18.2	20 (Tb)	resistance to soldering heat	unmounted components; (260 \pm 5) °C; (10 \pm 1) s	$\pm (0.01 \% R + 0.01 \Omega)$ no visible damage	
4.17	20 (Ta)	solderability	+ 235 °C; 2 s solder bath method	good tinning (\geq 95 % coverage);	
4.22	6 (B4)	vibration	6 h; 10 Hz to 2000 Hz 1.5 mm or 196 m/s ²	$\pm (0.01 \% R + 0.01 \Omega)$; no visible damage	
4.16	21 (Ua ₁) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	$\pm (0.01 \% R + 0.01 \Omega)$; no visible damage	
4.7	-	voltage proof	$U_{RMS} = U_{ins}$; 60 s	no flashover or breakdown	
4.12	-	noise	IEC 60 195: $R \leq 100 \text{ k}\Omega$ $R > 100 \text{ k}\Omega$	max. 0.25 $\mu\text{V/V}$ max. 0.5 $\mu\text{V/V}$	

Metal Film Resistors, Precision, Ultra-High Stability



FEATURES

- Extremely low temperature coefficient of resistance
- Very low noise and voltage coefficient
- Very good high frequency characteristics
- Can replace wirewound bobbins
- Proprietary epoxy coating provides superior moisture protection
- Lead (Pb)-free version is RoHS compliant



RoHS*
COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS

GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{85\text{ }^\circ\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX. V_{\equiv}	TEMPERATURE COEFFICIENT ppm/°C	TOLERANCE %	RESISTANCE RANGE Ω
PTF51	PTF-51	0.05	200	5, 10, 15	0.02, 0.05, 0.1, 0.25, 0.5, 1	15R to 100K
PTF56	PTF-56	0.125	300	5, 10, 15	0.01, 0.02, 0.05, 0.1, 0.25, 0.5, 1	15R to 500K
PTF65	PTF-65	0.25	500	5, 10, 15	0.05, 0.1, 0.25, 0.5, 1	15R to 1M0

Note:

- Marking: Print-marked-model, Value, Tolerance, TC, Date code

TEMPERATURE COEFFICIENT CODES

GLOBAL TC CODE	HISTORICAL TC CODE	TEMPERATURE COEFFICIENT
Z	T-16	5 ppm/°C
Y	T-13	10 ppm/°C
X	T-10	15 ppm/°C

TECHNICAL SPECIFICATIONS

PARAMETER	UNIT	PTF51	PTF56	PTF65
Rated Dissipation at 85 °C	W	0.05	0.125	0.25
Limiting Element Voltage	V_{\equiv}	200	300	500
Insulation Voltage (1 Min)	V_{eff}	> 500	> 500	> 500
Thermal Resistance	K/W	< 1300	< 520	260
Terminal Strength, Axial	N	> 150	> 50	> 50
Insulation Resistance	Ω	$\geq 10^{11}$	$\geq 10^{11}$	$\geq 10^{11}$
Category Temperature Range	°C	- 55 to + 150	- 55 to + 150	- 55 to + 150
Failure Rate	$10^{-9}/\text{h}$	< 1	< 1	< 1
Weight (Max.)	g	0.11	0.35	0.75

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: PTF5620K500BYRE (preferred part numbering format)

P T F 5 6 2 0 K 5 0 0 B Y R E

GLOBAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	TEMP. COEFFICIENT	PACKAGING	SPECIAL
PTF51 PTF56 PTF65	R = Decimal K = Thousand M = Million 15R000 = 15 Ω 500K00 = 500 k Ω 1M0000 = 1.0 M Ω	T = $\pm 0.01\%$ (1) Q = $\pm 0.02\%$ (1) A = $\pm 0.05\%$ B = $\pm 0.1\%$ C = $\pm 0.25\%$ D = $\pm 0.5\%$ F = $\pm 1\%$	Z = 5 ppm Y = 10 ppm X = 15 ppm 0 = Special	EK = Lead (Pb)-free, Bulk EA = Lead (Pb)-free, T/R (Full) EB = Lead (Pb)-free, T/R (1000 pieces) BF = Tin/Lead, Bulk RE = Tin/Lead, T/R (Full) R6 = Tin/Lead, T/R (1000 pieces)	Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable

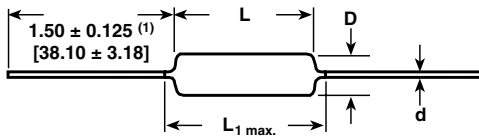
Historical Part Number example: PTF-5620K5BT-13R36 (will continue to be accepted)

PTF-56	20K5	B	T-13	R36
HISTORICAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	TEMP. COEFFICIENT	PACKAGING

Note:

(1) Historical tolerance codes were BB for 0.01 % and BC for 0.02 %

* Pb containing terminations are not RoHS compliant, exemptions may apply

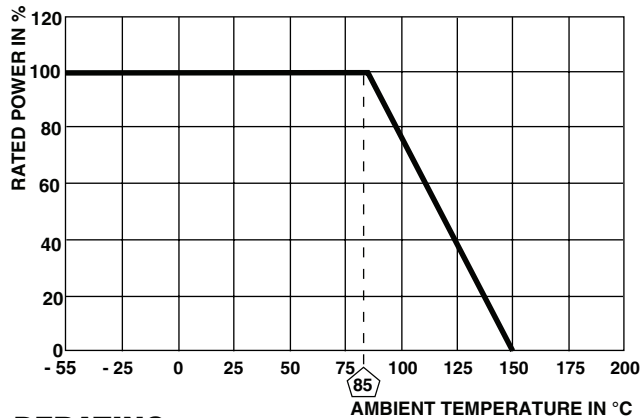
DIMENSIONS

Note:

 (1) 1.08 ± 0.125 [27.43 ± 3.18] if tape and reel

GLOBAL MODEL	DIMENSIONS in inches [millimeters]			
	L	D	L ₁ max.	d
PTF51	0.150 ± 0.020 [3.81 ± 0.51]	0.070 ± 0.010 [1.78 ± 0.25]	0.200 [5.08]	0.016 [0.41]
PTF56	0.250 ± 0.031 [6.35 ± 0.79]	0.091 ± 0.009 [2.31 ± 0.23]	0.300 [7.62]	0.025 [0.64]
PTF65	0.375 ± 0.062 [9.53 ± 1.57]	0.145 ± 0.016 [3.68 ± 0.41]	0.475 [12.07]	0.025 [0.64]

PERFORMANCE

TEST	CONDITIONS OF TEST	TEST RESULTS
Life	MIL-PRF-55182 Paragraph 4.8.18 1000 h rated power at + 85 °C	≤ ± 0.04 %
Thermal Shock	MIL-STD-202, Method 107 - 55 °C to + 85 °C	≤ ± 0.02 %
Short Time Overload	MIL-R-10509, Paragraph 4.7.6	≤ ± 0.01 %
Low Temperature Operation	MIL-PRF-55182, Methods 4.8.10	≤ ± 0.02 %
Moisture	MIL-PRF-55182, Paragraph 4.8.15	≤ ± 0.08 %
Resistance to Soldering Heat	MIL-STD-202, Methods 210	≤ ± 0.02 %
Damp Heat IEC 60068-2-3	56 days at 40 °C and 92 % RH	≤ ± 0.08 %
Dielectric Withstanding Voltage	MIL-STD-202, Methods 301 and 105	≤ ± 0.01 %


DERATING
MATERIAL SPECIFICATIONS

Element:	Precision deposited nickel chrome alloy with controlled annealing
Encapsulation:	Specially formulated epoxy compounds. Coated construction
Core:	Fire-cleanded high purity ceramic
Termination:	Standard lead material is solder-coated copper. Solderable and weldable per MIL-STD-1276, Type C.

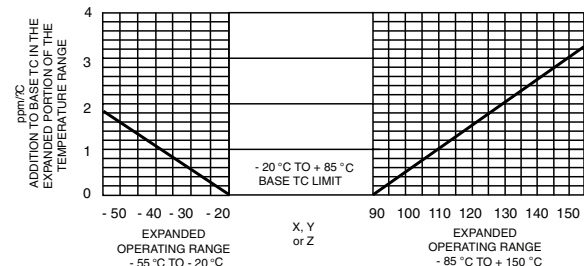
TEMPERATURE COEFFICIENT OF RESISTANCE

Temperature coefficient (TC) of resistance is normally stated as the maximum amount of resistance change from the original + 25 °C value as the ambient temperature increases or decreases. This is most commonly expressed in parts per million per degree centigrade (ppm/°C).

The resistance curve over the operating temperature range is usually a non-linear curve within predictable maximum limits. PTF resistors have a very uniform resistance temp. characteristic when measured over the operating range of - 20 °C to + 85 °C. The standard temperature coefficients available are

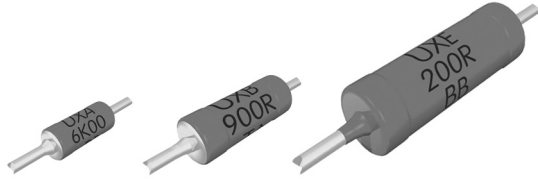
X = ± 15 ppm/°C, Y = ± 10 ppm/°C and Z = ± 5 ppm/°C.

Some applications of the PTF require operation beyond the specifications of - 20 °C to + 85 °C. The change in temperature coefficient of resistance is very small (less than ± 0.05 ppm/°C) over the expanded temperature range of - 55 °C to ± 150 °C. Therefore, when operating outside the range - 20 °C to + 85 °C, the designer can plan for a worst case addition of ± 0.05 ppm/°C for each degree centigrade beyond either - 20 °C or + 85 °C as indicated in the graph. This applies to all three temperature coefficient codes.



Example: Assume the operating characteristics demand a temperature range from - 55 °C to + 125 °C. This requires a ± 35 °C Δ below - 20 °C and a ± 40 °C Δ above + 85 °C. The extreme Δ being ± 40 °C means that the worst case addition to the specified TC limit of ± 0.05 ppm/°C times ± 40 °C or ± 2 ppm/°C. Therefore, a Z which is characterized by a base TC limit of ± 5 ppm/°C over the temperature range of - 20 °C to ± 85 °C will exhibit a maximum temperature coefficient of ± 7 ppm/°C over the expanded portion of the temperature range of - 55 °C to + 125 °C.

High Precision Leaded Resistors



DESCRIPTION

UXA 0204, UXB 0207 and UXE 0414 high precision leaded thin film resistors combine the proven reliability of the professional products with an exceptional level of precision and stability. Therefore they are perfectly suited for applications in the fields of precision test and measuring equipment and particularly for the design of calibration references and standards.

FEATURES

- Superior thin film technology
- Exceptional low TCR: ± 02 ppm/K to ± 10 ppm/K
- Super tight tolerance: ± 0.01 % to ± 0.25 %
- Exceptional overall stability: class 0.02
- Wide resistance range: 22Ω to $1 \text{ M}\Omega$
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- Precision test and measuring equipment
- Design of calibration references and standards

METRIC SIZE

DIN:	0204	0207	0414
CECC:	A	B	D

TECHNICAL SPECIFICATIONS

DESCRIPTION	UXA 0204	UXB 0207	UXE 0414
CECC Size	A	B	D
Resistance Range	22Ω to $221 \text{ k}\Omega$	10Ω to $1 \text{ M}\Omega$	22Ω to $511 \text{ k}\Omega$
Resistance Tolerance	± 0.25 %; ± 0.1 %; ± 0.05 %; ± 0.01 %		± 0.1 %; ± 0.05 %
Temperature Coefficient	± 10 ppm/K; ± 05 ppm/K; ± 02 ppm/K		± 10 ppm/K; ± 05 ppm/K
Operation Mode	precision	precision	precision
Climatic Category (LCT/UCT/days)	20/125/56	20/125/56	20/125/56
Rated Dissipation:			
P_{85}	0.05 W	0.125 W	0.25 W
P_{70}	0.1 W	0.25 W	0.5 W
Operating Voltage, U_{max} , AC/DC	200 V	250 V	300 V
Film Temperature	$125 \text{ }^\circ\text{C}$	$125 \text{ }^\circ\text{C}$	$125 \text{ }^\circ\text{C}$
Max. Resistance Change at P_{70} for Resistance Range, $\Delta R/R$ max., After:	100Ω to $100 \text{ k}\Omega$	100Ω to $250 \text{ k}\Omega$	100Ω to $100 \text{ k}\Omega$
2000 h	≤ 0.05 %	≤ 0.05 %	≤ 0.05 %
Max. Resistance Change at P_{85} for Resistance Range, $\Delta R/R$ max., After:	100Ω to $100 \text{ k}\Omega$	100Ω to $250 \text{ k}\Omega$	100Ω to $100 \text{ k}\Omega$
1000 h	≤ 0.02 %	≤ 0.02 %	≤ 0.02 %
8000 h	≤ 0.04 %	≤ 0.04 %	≤ 0.04 %
225 000 h	≤ 0.12 %	≤ 0.12 %	≤ 0.12 %
Specified Lifetime	225 000 h	225 000 h	225 000 h
Permissible Voltage Against Ambient :			
1 Min; U_{ins}	300 V	500 V	800 V
Continuous	75 V	75 V	75 V
Failure Rate	$\leq 0.7 \times 10^{-9}/\text{h}$	$\leq 0.3 \times 10^{-9}/\text{h}$	$\leq 0.1 \times 10^{-9}/\text{h}$



UXA 0204, UXB 0207, UXE 0414

High Precision Leaded Resistors

Vishay Beyschlag

12NC INFORMATION

Components may be ordered by using either a simple clear text ordering code, see "Type Description and Ordering Code" or Vishay BCcomponents' unique 12NC.

Numeric Ordering Code (12NC)

- The resistors have a 12-digit Part Number starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see the 12NC Part Number table.
- The remaining 4 digits indicate the resistance value:
 - The first 3 digits indicate the resistance value.
 - The last digit indicates the resistance decade in accordance with the 12NC Indicating Resistance Decade table.

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
10 Ω to 99.9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9.99 kΩ	2
10 kΩ to 99.9 kΩ	3
100 kΩ to 999 kΩ	4

12NC Example

The Part Number of a UXA 0204 resistor, value 47 kΩ and TCR 10 with ± 0.1 % tolerance, supplied on bandolier in a box of 1000 units is: 2312 662 34703.

12NC PART NUMBER - resistor type and packaging							
DESCRIPTION			ORDERING CODE 2312				
			BANDOLIER IN BOX	BANDOLIER IN BOX	BANDOLIER ON REEL	BANDOLIER ON REEL	BANDOLIER ON REEL
TYPE	TCR	TOL.	CU 100 units	C1 1000 units	R1 1000 units	R2 2500 units	RP 5000 units
UXA 0204	± 10 ppm/K	± 0.25 %	562 2....	662 2....	462 2....	-	-
		± 0.1 %	562 3....	662 3....	462 3....	-	-
		± 0.05 %	562 4....	662 4....	462 4....	-	-
		± 0.01 %	562 7....	662 7....	462 7....	-	-
		(1)	562 91...	662 91...	462 91...	-	-
	± 05 ppm/K	± 0.25 %	563 2....	663 2....	463 2....	-	-
		± 0.1 %	563 3....	663 3....	463 3....	-	-
		± 0.05 %	563 4....	663 4....	463 4....	-	-
		± 0.01 %	563 7....	663 7....	463 7....	-	-
		(1)	563 91...	663 91...	463 91...	-	-
	± 02 ppm/K	± 0.25 %	564 2....	664 2....	464 2....	-	-
		± 0.1 %	564 3....	664 3....	464 3....	-	-
± 0.05 %		564 4....	664 4....	464 4....	-	-	
± 0.01 %		564 7....	664 7....	464 7....	-	-	
(1)		564 91...	664 91...	464 91...	-	-	
UXB 0207	± 10 ppm/K	± 0.25 %	572 2....	672 2....	472 2....	-	577 2....
		± 0.1 %	572 3....	672 3....	472 3....	-	577 3....
		± 0.05 %	572 4....	672 4....	472 4....	-	577 4....
		± 0.01 %	572 7....	672 7....	472 7....	-	577 7....
		(1)	572 91...	672 91...	472 91...	-	577 91...
	± 05 ppm/K	± 0.25 %	573 2....	673 2....	473 2....	-	578 2....
		± 0.1 %	573 3....	673 3....	473 3....	-	578 3....
		± 0.05 %	573 4....	673 4....	473 4....	-	578 4....
		± 0.01 %	573 7....	673 7....	473 7....	-	578 7....
		(1)	573 91...	673 91....	473 91...	-	578 91...
	± 02 ppm/K	± 0.25 %	574 2....	674 2....	474 2....	-	579 2....
		± 0.1 %	574 3....	674 3....	474 3....	-	579 3....
± 0.05 %		574 4....	674 4....	474 4....	-	579 4....	
± 0.01 %		574 7....	674 7....	474 7....	-	579 7....	
(1)		574 91...	674 91...	474 91...	-	579 91...	
UXE 0414	± 10 ppm/K	± 0.1 %	592 3....	692 3....	-	597 3....	-
		± 0.05 %	592 4....	692 4....	-	597 4....	-
		(1)	592 91...	692 91...	-	597 91...	-
	± 05 ppm/K	± 0.1 %	593 3....	693 3....	-	598 3....	-
		± 0.05 %	593 4....	693 4....	-	598 4....	-
		(1)	593 91...	693 91...	-	598 91...	-

Note:

(1) Readable 12NC coding of resistance values is restricted to values with three significant digits. For resistance values with more than three significant digits, a non readable sequential number will be issued by the factory for each requested combination of resistance value and tolerance.

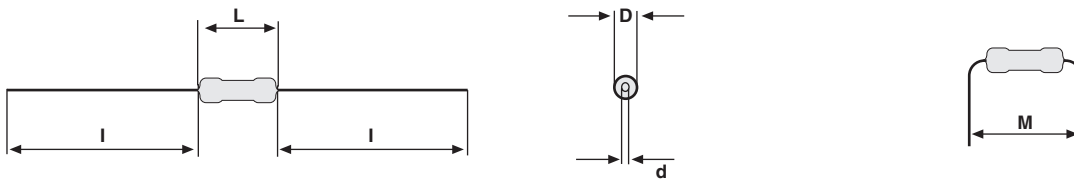
PART NUMBER AND PRODUCT DESCRIPTION UX SERIES						
PARTNUMBERING: UXB02070F1001AC100						
<div style="display: flex; justify-content: space-around; font-weight: bold; font-size: 1.2em;"> UXB02070F1001AC100 </div>						
MODEL/SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING ⁽¹⁾	SPECIAL
UXA0204 UXB0207 UXE0414	0 = Neutral	H = ± 2 ppm/K G = ± 5 ppm/K F = ± 10 ppm/K	3 digit value 1 digit multiplier MULTIPLIER 9 = *10 ⁻¹ 2 = *10 ² 0 = *10 ⁰ 3 = *10 ³ 1 = *10 ¹ 4 = *10 ⁴	T = ± 0.01 % A = ± 0.05 % B = ± 0.1 % C = ± 0.25 %	C1 CU R1 R2 RP	Up to 2 digits 00 = Standard
PRODUCT DESCRIPTION: UXB 0207-10 0.05 % C1 1K0						
UXB	0207	10	0.05 %	C1	1K0	
MODEL	SIZE	TCR	TOLERANCE	PACKAGING ⁽¹⁾	RESISTANCE VALUE	
UXA UXB UXE	0204 0207 0414	± 2 ppm/K ± 5 ppm/K ± 10 ppm/K	± 0.01 % ± 0.05 % ± 0.1 % ± 0.25 %	C1 CU R1 R2 RP	1K0 = 1.0 kΩ 47K = 47 kΩ 50R5 = 50.5 Ω	

Notes:

⁽¹⁾Please refer to table PACKAGING, see next page

- Products can be ordered using either the Product Description or the 12NC. The PART NUMBER is shown to facilitate the introduction of a unified part numbering system.

DIMENSIONS



DIMENSIONS - leaded resistor types, mass and relevant physical dimensions						
TYPE	D _{max.} (mm)	L _{max.} (mm)	d _{nom.} (mm)	I _{min.} (mm)	M _{min.} (mm)	MASS (mg)
UXA 0204	1.6	3.6	0.5	29.0	5.0	125
UXB 0207	2.5	6.3	0.6	28.0	7.5	220
UXE 0414	4.0	11.9	0.8	31.0	15.0	750

SCRIPT MARKING - printed resistance value and letter coding for TCR and tolerance				
RESISTANCE VALUE	TOL. (%)	LETTER CODE	TCR (ppm/K)	LETTER CODE
Clear text code for value	± 0.25	C	± 10	B
	± 0.1	B	± 05	A
	± 0.05	A	± 02	T
	± 0.01	T	-	-



PACKAGING				
MODEL	REEL		BOX	
	BANDOLIER ON REEL	CODE	PIECES/BOX	CODE
UXA	1000	R1	100 1000	CU C1
UXB	1000 5000	R1 RP	100 1000	CU C1
UXE	2500	R2	100 1000	CU C1

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
DESCRIPTION		RESISTANCE VALUE ⁽¹⁾		
TCR	TOLERANCE	UXA 0204	UXB 0207	UXE 0414
± 10 ppm/K ⁽²⁾	± 0.25 %	22 Ω to 221 kΩ	10 Ω to 1 MΩ	-
	± 0.1 %	43 Ω to 221 kΩ	10 Ω to 1 MΩ	22 Ω to 511 kΩ
	± 0.05 %	100 Ω to 180 kΩ	24 Ω to 301 kΩ	100 Ω to 301 kΩ
	± 0.01 %	200 Ω to 150 kΩ	24 Ω to 301 kΩ	-
± 05 ppm/K ⁽²⁾	± 0.25 %	47 Ω to 150 kΩ	10 Ω to 1 MΩ	-
	± 0.1 %	47 Ω to 150 kΩ	10 Ω to 1 MΩ	47 Ω to 301 kΩ
	± 0.05 %	100 Ω to 150 kΩ	24 Ω to 221 kΩ	100 Ω to 301 kΩ
	± 0.01 %	200 Ω to 150 kΩ	24 Ω to 221 kΩ	-
± 02 ppm/K ⁽³⁾	± 0.25 %	100 Ω to 100 kΩ	100 Ω to 150 kΩ	-
	± 0.1 %	100 Ω to 100 kΩ	100 Ω to 150 kΩ	-
	± 0.05 %	150 Ω to 100 kΩ	150 Ω to 150 kΩ	-
	± 0.01 %	200 Ω to 100 kΩ	200 Ω to 150 kΩ	-

Notes:

⁽¹⁾ Resistance values to be selected from the E192 series, for other values please contact the factory.

⁽²⁾ TCR 10 and TCR 05 are specified over the temperature range from - 20 °C to + 85 °C.

⁽³⁾ TCR 02 is specified over the temperature range from 0 °C to + 60 °C.

DESCRIPTION

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 (85 % Al₂O₃) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the metallized rods. Special laser devices are used repeatedly to achieve the target value by slowly and smoothly cutting a helical groove in the resistive layer without damaging the ceramics. A further conditioning is applied in order to stabilise the trimming result. Connecting wires of electrolytic copper plated with pure tin are welded to the termination caps. The resistors are covered by protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating. Script marking designates the resistance value plus coded TCR and tolerance.

The result of the determined production is verified by an accelerated ageing (burn-in) and extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are stuck directly on the adhesive tapes in accordance with **IEC 60286-1**.

ASSEMBLY

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. Excellent solderability is proven, even after extended storage. They are suitable for automatic soldering using wave or dipping. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

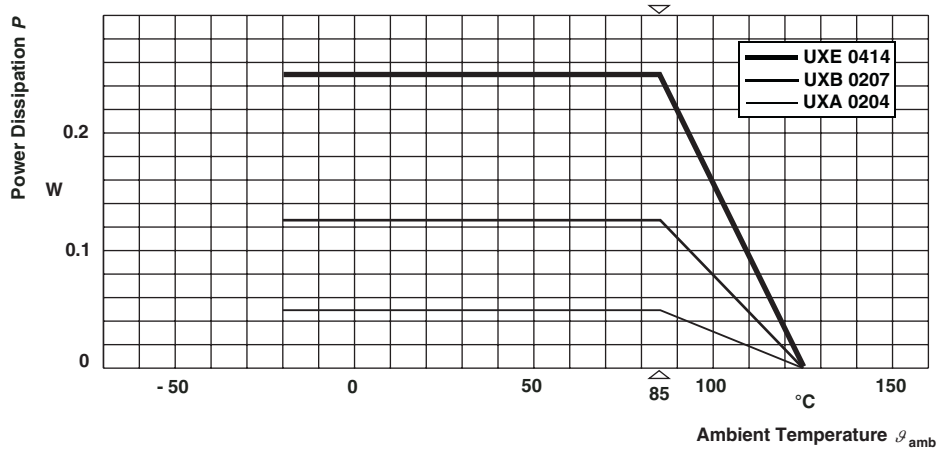
APPROVALS

Where applicable, the resistors are tested in accordance with **CECC 40101-806** which refers to **EN 60115-1** and **EN 140100**.

Vishay BEYSCHLAG has achieved “**Approval of Manufacturer**” in accordance with **EN 100114-1**

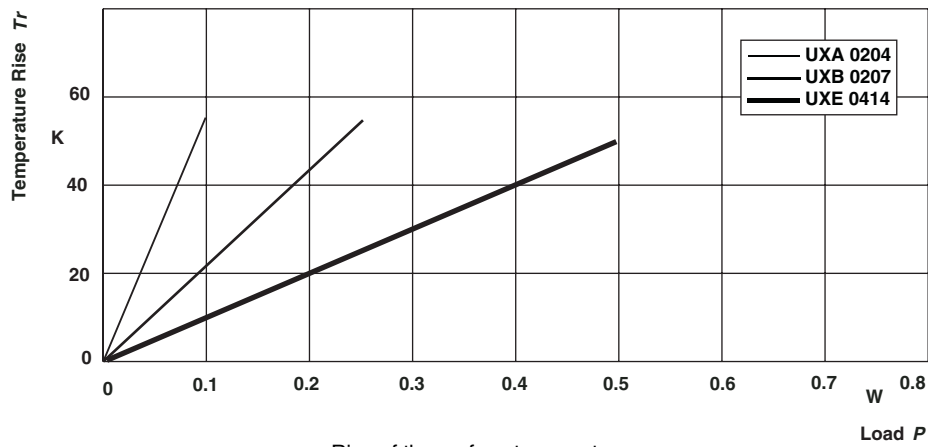


FUNCTIONAL DESCRIPTION



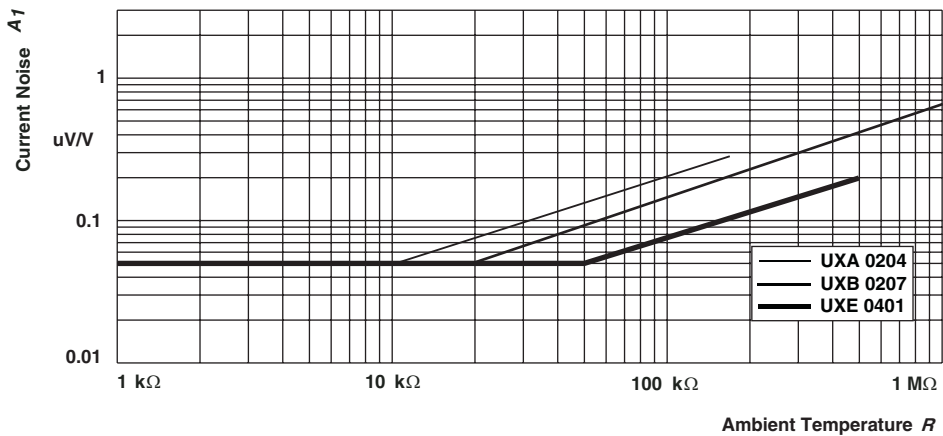
Specification of TCR 02 is valid from 0 °C to 60 °C.

Derating - Precision Operation



Rise of the surface temperature.

Temperature Rise



Current Noise A_1 In Accordance With IEC 60 195



TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the following specifications:

EN 140000/IEC 60115-1, Generic specification (includes tests)

EN 140100/IEC 60115-2, Sectional specification (includes schedule for qualification approval)

CECC 40101-806, Detail specification (includes schedule for conformance inspection)

Most of the components are approved in accordance with the European CECC-system, where applicable. The Test Procedures and Requirements table contains only the most important tests. For the full test schedule refer to the documents listed above. The testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5202.

The tests are carried out in accordance with IEC 60 068 and under standard atmospheric conditions in accordance with

IEC 60068-1, 5.3. Climatic category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days) is valid.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 45 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

For testing the components are mounted on a test board in accordance with IEC 60115-1, 4.31 unless otherwise specified.

In the Test Procedures and Requirements table only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2; a short description of the test procedure is also given.

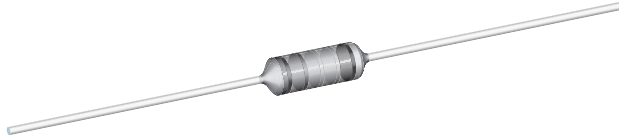
TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
			Stability for product types:			
			UXA 0204	100 Ω to 100 k Ω	22 Ω to < 100 Ω ; > 100 k Ω to 221 k Ω	-
			UXB 0207	100 Ω to 250 k Ω	40.2 Ω to < 100 Ω ; > 250 k Ω to 301 k Ω	10 Ω to < 40.2 Ω ; > 301 k Ω to 1 M Ω
			UXE 0414	100 Ω to 100 k Ω	22 Ω to < 100 Ω ; > 100 k Ω to 511 k Ω	-
4.5	-	resistance ($\Delta R/R$)		$\pm 0.25\%$; $\pm 0.1\%$; $\pm 0.05\%$; $\pm 0.01\%$		
4.8.4.2	-	temperature coefficient	at 20/LCT/20 °C and 20/UCT/20 °C	± 10 ppm/K; ± 05 ppm/K; ± 02 ppm/K		
4.25.1	-	endurance	room temperature; $U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h ON; 0.5 h OFF			
			70 °C; 2000 h	$\pm (0.05\% R + 0.01 \Omega)$	$\pm (0.05\% R + 0.01 \Omega)$	$\pm (0.05\% R + 0.01 \Omega)$
			85 °C; 1000 h	$\pm (0.02\% R + 0.01 \Omega)$	$\pm (0.03\% R + 0.01 \Omega)$	$\pm (0.04\% R + 0.01 \Omega)$
			85 °C; 8000 h	$\pm (0.04\% R + 0.01 \Omega)$	$\pm (0.06\% R + 0.01 \Omega)$	$\pm (0.08\% R + 0.01 \Omega)$

TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
			Stability for product types:			
			UXA 0204	100 Ω to 100 k Ω	22 Ω to < 100 Ω ; > 100 k Ω to 221 k Ω	-
			UXB 0207	100 Ω to 250 k Ω	40.2 Ω to < 100 Ω ; > 250 k Ω to 301 k Ω	10 Ω to < 40.2 Ω ; > 301 k Ω to 1 M Ω
			UXE 0414	100 Ω to 100 k Ω	22 Ω to < 100 Ω ; > 100 k Ω to 511 k Ω	-
4.25.3	-	endurance at upper category temperature	125 $^{\circ}$ C; 1000 h	\pm (0.04 % R + 0.01 Ω)	\pm (0.06 % R + 0.01 Ω)	\pm (0.08 % R + 0.01 Ω)
4.24	3 (Ca)	damp heat, steady state	(40 \pm 2) $^{\circ}$ C; 56 days; (93 \pm 3) % RH	\pm (0.04 % R + 0.01 Ω)	\pm (0.05 % R + 0.01 Ω)	\pm (0.06 % R + 0.01 Ω)
4.23		climatic sequence:				
4.23.2	2 (Ba)	dry heat	125 $^{\circ}$ C; 16 h			
4.23.3	30 (Db)	damp heat, cyclic	55 $^{\circ}$ C; 24 h; 90 % to 100 % RH; 1 cycle			
4.23.4	1 (Aa)	cold	- 55 $^{\circ}$ C; 2 h			
4.23.5	13 (M)	low air pressure	8.5 kPa; 2 h; 15 $^{\circ}$ C to 35 $^{\circ}$ C			
4.23.6	30 (Db)	damp heat, cyclic	55 $^{\circ}$ C; 5 days; 95 % to 100 % RH; 5 cycles	\pm (0.04 % R + 0.01 Ω) no visible damage	\pm (0.05 % R + 0.01 Ω) no visible damage	\pm (0.06 % R + 0.01 Ω) no visible damage
4.13	-	short time overload	room temperature; $U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; 5 s	\pm (0.01 % R + 0.01 Ω) no visible damage	\pm (0.01 % R + 0.01 Ω) no visible damage	\pm (0.02 % R + 0.01 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 min at LCT and 30 min at UCT; 5 cycles	\pm (0.01 % R + 0.01 Ω) no visible damage	\pm (0.01 % R + 0.01 Ω) no visible damage	\pm (0.02 % R + 0.01 Ω) no visible damage
4.29	45 (XA)	component solvent resistance	isopropyl alcohol + 23 $^{\circ}$ C; toothbrush method	marking legible; no visible damage		
4.18.2	20 (Tb)	resistance to soldering heat	unmounted components; (260 \pm 5) $^{\circ}$ C; (10 \pm 1) s	\pm (0.01 % R + 0.01 Ω) no visible damage	\pm (0.01 % R + 0.01 Ω) no visible damage	\pm (0.02 % R + 0.01 Ω) no visible damage
4.17	20 (Ta)	solderability	+ 235 $^{\circ}$ C; 2 s solder bath method	good tinning (\geq 95 % coverage, no visible damage)		
4.22	6 (B4)	vibration	6 h; 10 Hz to 2000 Hz 1.5 mm or 196 m/s ²	\pm (0.01 % R + 0.01 Ω)	\pm (0.01 % R + 0.01 Ω)	\pm (0.02 % R + 0.01 Ω)



TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
			Stability for product types:			
			UXA 0204	100 Ω to 100 k Ω	22 Ω to < 100 Ω ; > 100 k Ω to 221 k Ω	-
			UXB 0207	100 Ω to 250 k Ω	40.2 Ω to < 100 Ω ; > 250 k Ω to 301 k Ω	10 Ω to < 40.2 Ω ; > 301 k Ω to 1 M Ω
			UXE 0414	100 Ω to 100 k Ω	22 Ω to < 100 Ω ; > 100 k Ω to 511 k Ω	-
4.16	21 (Ua ₁) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	$\pm (0.01 \% R + 0.01 \Omega)$	$\pm (0.01 \% R + 0.01 \Omega)$	$\pm (0.02 \% R + 0.01 \Omega)$
4.7	-	voltage proof	$U_{RMS} = U_{ins}; 60 \text{ s}$	no flashover or breakdown		

Metal Film Resistors, Industrial Power, Flameproof



FEATURES

- Small size suitable for 1/2, 1 and 2 W applications
- High power rating, small size
- Flameproof, high temperature coating meets EIA RS-325-A
- Excellent high frequency characteristics
- Low noise
- Low voltage coefficient
- Tape and reel packaging for automatic insertion (52.4 mm inside tape spacing per EIA-296-E)
- Lead (Pb)-free version is RoHS compliant



RoHS*
COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS							
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{70^\circ\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX. V_{\equiv}	TEMPERATURE COEFFICIENT ppm/ $^\circ\text{C}$	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
CCF02	CCF-2	2.0	350	100	$\pm 1, \pm 5$	4R99 - 1M	96 for 1 % tolerance 24 for 5 % tolerance

TECHNICAL SPECIFICATIONS		
PARAMETER	UNIT	CCF02
Rated Dissipation at 70 $^\circ\text{C}$	W	2.0
Maximum Working Voltage	V_{\equiv}	≤ 350
Insulation Voltage (1 Min)	V_{eff}	> 500
Dielectric Strength	V_{AC}	900
Insulation Resistance	Ω	$\geq 10^{11}$
Operating Temperature Range	$^\circ\text{C}$	- 65/+ 230
Terminal Strength (Pull Test)	lb	2
Failure Rate	$10^{-9}/\text{h}$	< 1
Weight (Max.)	g	0.35

MATERIAL SPECIFICATIONS	
Element:	Proprietary nickel-chrome film
Solderability:	Satisfactory per MIL-STD-202, Method 208.
Core:	Fire-cleaned high purity ceramic
Termination:	Standard lead material is solder-coated copper. Solderable and weldable per MIL-STD-1276, Type C.

MARKING	
-	5 band colorband for $\pm 1\%$
-	4 band colorband for $\pm 5\%$

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: CCF02301RFKR36 (preferred part numbering format)

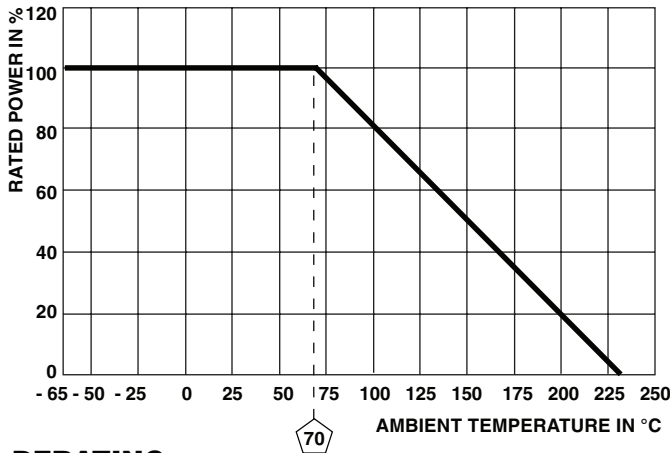
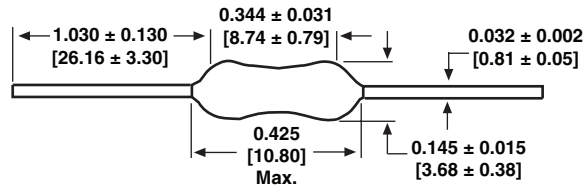
C	C	F	0	2	3	0	1	R	F	K	R	3	6			
GLOBAL MODEL		RESISTANCE VALUE				TOLERANCE CODE		TEMPERATURE COEFFICIENT		PACKAGING			SPECIAL			
CCF02		R = Decimal K = Thousand M = Million 4R99 = 4.99 Ω 680K = 680 k Ω 1M00 = 1.0 M Ω				F = $\pm 1\%$ J = $\pm 5\%$		K = 100 ppm		E36 = Lead (Pb)-free, T/R (2500 pieces) R36 = Tin/Lead, T/R (2500 pieces)			Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable			

Historical Part Number example: CCF-23010F (will continue to be accepted)

CCF-2	3010	F	R36
HISTORICAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING

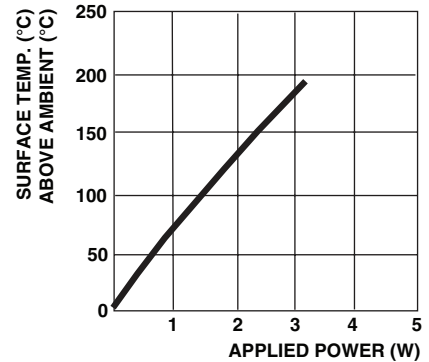
* Pb containing terminations are not RoHS compliant, exemptions may apply

DIMENSIONS in inches [millimeters]



Surface temperatures were taken with an infrared pyrometer in + 25 °C still air.

Resistors were supported by their leads in test clips at a point 0.5" [12.70 mm] out from the resistor body ends.

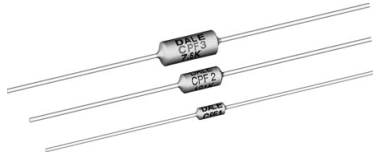


DERATING

SURFACE TEMPERATURE vs POWER

PERFORMANCE	
TEST	MAX. ΔR (Typical Test Lots)
Thermal Shock	± 1.0 %
Short Time Overload	± 0.5 %
Low Temperature Operation	± 0.5 %
Moisture Resistance	± 1.5 %
Resistance to Soldering Heat	± 0.5 %
Shock	± 0.5 %
Vibration	± 0.5 %
Terminal Strength	± 0.5 %
Dielectric Withstanding Voltage	± 0.5 %
Life	± 2.0 %

Metal Film Resistors, Industrial Power, Flameproof



FEATURES

- High power rating, small size
- Flameproof. high temperature coating
- Special filming and coating processes
- Excellent high frequency characteristics
- Low noise
- Low voltage coefficient
- Lead (Pb)-free version is RoHS compliant



RoHS*
COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS									
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{70\text{ }^\circ\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX V_{\equiv}	RESISTANCE RANGE Ω					
				0.1 % - 1 %	0.1 % - 5 %	0.5 % - 5 %	1 % - 5 %	1 %	2 % - 5 %
				25 ppm	50 ppm	100 ppm	150 ppm	200 ppm	200 ppm
CPF1	CPF-1	1	250	5 - 150K	5 - 150K	1 - 150K	R5 - 150K	R5 - 150K	R1 - 150K
CPF2	CPF-2	2	350	5 - 150K	5 - 150K	1 - 150K	R5 - 150K	R5 - 150K	R1 - 150K
CPF3	CPF-3	3	500	8 - 150K	8 - 150K	1 - 150K	1 - 150K	1 - 150K	R1 - 150K

Note:

Marking: Print marked - DALE, Model, Resistance value, Tolerance/Temperature Coefficient, Date Code

TEMPERATURE COEFFICIENT CODES		
GLOBAL TC CODE	HISTORICAL TC CODE	TEMPERATURE COEFFICIENT
E	T-9	25 ppm/ $^\circ\text{C}$
H	T-2	50 ppm/ $^\circ\text{C}$
K	T-1	100 ppm/ $^\circ\text{C}$
L	T-0	150 ppm/ $^\circ\text{C}$
N	T-00	200 ppm/ $^\circ\text{C}$

TECHNICAL SPECIFICATIONS				
PARAMETER	UNIT	CPF1	CPF2	CPF3
Rated Dissipation at 70 $^\circ\text{C}$	W	1	2	3
Limiting Element Voltage ⁽¹⁾	V_{\equiv}	250	350	500
Insulation Voltage	V-	900	900	900
Thermal Resistance	K/W	85	60	50
Insulation Resistance	Ω	10 ¹⁰		
Category Temperature Range	$^\circ\text{C}$	- 65 $^\circ\text{C}$ /+ 230 $^\circ\text{C}$		

Note:

⁽¹⁾ Rated Voltage $\sqrt{P \times R}$

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: CPF1562R00FKR36 (preferred part numbering format)

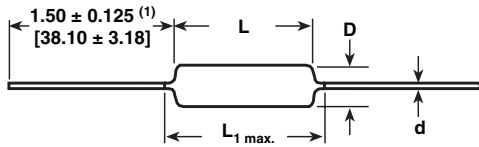
C	P	F	1	5	6	2	R	0	0	F	K	R	3	6			
GLOBAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	TEMPERATURE COEFFICIENT	PACKAGING			SPECIAL										
CPF1 CPF2 CPF	R = Decimal K = Thousand R10000 = 0.1 Ω 10R000 = 10 Ω 150K00 = 150 Ω	B = $\pm 0.1\%$ C = $\pm 0.25\%$ D = $\pm 0.5\%$ F = $\pm 1\%$ G = $\pm 2\%$ J = $\pm 5\%$	E = 25 ppm H = 50 ppm K = 100 ppm L = 150 ppm N = 200 ppm	E14 = Lead (Pb)-free, Bulk E36 = Lead(Pb)-free, T/R (Full) EE6 = Lead (Pb)-free, T/R (1000 pieces) B14 = Tin/Lead, Bulk B36 = Tin/Lead, T/R (Full) BE6 = Tin/Lead, T/R (1000 pieces)			Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable										

Historical Part Number example: CPF-15620FT-1 R36 (will continue to be accepted)

CPF-1	5620	F	T-1	R36
HISTORICAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	TEMP. COEFFICIENT	PACKAGING

* Pb containing terminations are not RoHS compliant, exemptions may apply.

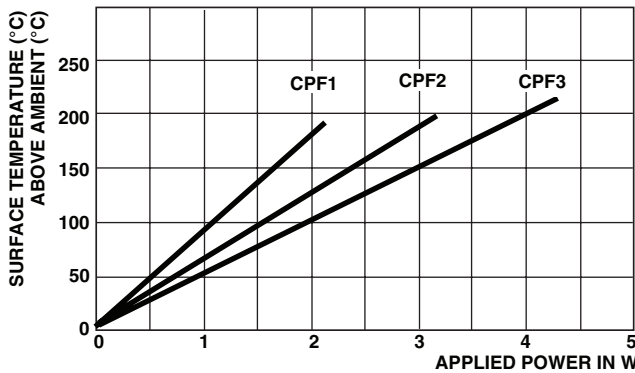
DIMENSIONS



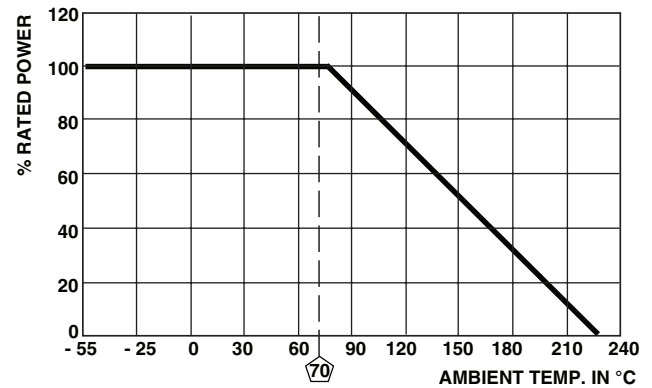
Notes:

- (1) 1.08 ± 0.125 [27.43 ± 3.18] if tape and reel
- Surface temperatures were taken with an infrared pyrometer in + 25 °C still air. Resistors were supported by their leads in test clips at a point 0.500" [12.70 mm] out from the resistor body ends.

GLOBAL MODEL	DIMENSIONS in inches [millimeters]			
	L	D	L _{1 max.}	d
CPF1	0.240 ± 0.020 [6.10 ± 0.51]	0.090 ± 0.008 [2.29 ± 0.20]	0.310 [7.87]	0.025 ± 0.002 [0.64 ± 0.05]
CPF2	0.344 ± 0.031 [8.74 ± 0.79]	0.145 ± 0.015 [3.68 ± 0.38]	0.425 [10.80]	0.032 ± 0.002 [0.81 ± 0.05]
CPF3	0.555 ± 0.041 [14.10 ± 1.04]	0.180 ± 0.015 [4.57 ± 0.381]	0.650 [16.51]	0.032 ± 0.002 [0.81 ± 0.05]



SURFACE TEMPERATURE VS. POWER



DERATING

MATERIAL SPECIFICATIONS	
Element:	Proprietary nickel-chrome alloy
Core:	Cleaned high purity ceramic
Coating:	Special high temperature conformal coat
Termination:	Standard lead material is solder-coated Solderable and weldable per MIL-STD-1276, Type C

MECHANICAL SPECIFICATIONS	
Terminal Strength:	2 pound pull test
Solderability:	Continuous satisfactory coverage when tested in accordance with MIL-STD-202, Method 208

PERFORMANCE	
TEST	MAX. ΔR (Typical Test Lots)
Thermal Shock	± 1.0 %
Short Time Overload	± 0.5 %
Low Temperature Operation	± 0.5 %
Moisture Resistance	± 1.5 %
Resistance To Soldering Heat	± 0.5 %
Shock	± 0.5 %
Vibration	± 0.5 %
Terminal Strength	± 0.5 %
Dielectric Withstanding Voltage	± 0.5 %
Life	± 2.0 %

Metal Film Resistors, Industrial, Flameproof



FEATURES

- Small physical size
- Low cost
- FP resistors have the ability to withstand overloads up to 100 times rated power without any trace of flame
- Exceptional frequency characteristics
- Especially suited for circuitry where functions, environments and duty cycles demand power resistors
- Electroplated tin-lead or lead (Pb)-free solder finish leads
- Tighter tolerances available on request
- Lead (Pb)-free version is RoHS compliant



RoHS*
COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS

GLOBAL MODEL	HISTORICAL MODEL	POWER RATING			VOLTAGE RATING	RESISTANCE RANGE Ω	STANDARD TOLERANCE %	TEMPERATURE COEFFICIENT ppm/ $^{\circ}$ C
		$P_{25^{\circ}\text{C}}$ W	$P_{40^{\circ}\text{C}}$ W	$P_{70^{\circ}\text{C}}$ W				
FP01/2	FP1/2	-	-	0.5	350	10R - 1M	1, 2, 5, 10	150
FP0001	FP1	-	-	1	500	10R - 1M	1, 2, 5, 10	150
FP0032	FP32	-	-	1	500	10R - 1M	1, 2, 5, 10	150
FP0002	FP2	3.5	3	2	500	9R - 1M5	1, 2, 5, 10	150
FP0042	FP42	-	-	2	500	10R - 1M5	1, 2, 5, 10	150
FP0003	FP3	4	4	3	500	9R - 1M	1, 2, 5, 10	150
FP0004	FP4	5.5	5	4	500	6R - 1M	1, 2, 5, 10	150
FP0005	FP5	6.5	6	5	600	7R - 1M	1, 2, 5, 10	150
FP0007	FP7	7.5	-	7	700	8R - 1M	1, 2, 5, 10	150
FP0010	FP10	-	10	-	700	8R - 1M	1, 2, 5, 10	150
FP0067	FP67	5	-	-	500	5R - 19K	1, 2, 5, 10	150
FP0069	FP69	3	-	2	500	2R6 - 1M5	1, 2, 5, 10	150

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: FP000251K1F9251B8 (preferred part numbering format)

F P 0 0 0 2 5 1 K 1 F 9 2 5 1 B 8

GLOBAL MODEL
(see Standard Electrical Specifications Table)

RESISTANCE VALUE
R = Decimal
K = Thousand
M = Million
10R0 = 10 Ω
1K30 = 1.3 k Ω
1M00 = 1.0 M Ω

TOLERANCE CODE
F = \pm 1 %
G = \pm 2 %
J = \pm 5 %
K = \pm 10 %

SPEC CODES
(see Spec Codes Table)

PACKAGING ⁽¹⁾
EK = Lead (Pb)-free, Bulk
EA = Lead (Pb)-free, T/R
B8 = Tin/Lead, Bulk
CH = Tin/Lead, T/R (750 pieces)
CJ = Tin/Lead, T/R (1000 pieces)
G1 = Tin/Lead, T/R (600 pieces)

Historical Part Number: FP25112F B8 (will continue to be accepted)

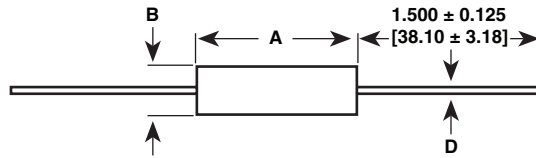


Note:

⁽¹⁾ Some packaging codes are model specific

* Pb containing terminations are not RoHS compliant, exemptions may apply

DIMENSIONS

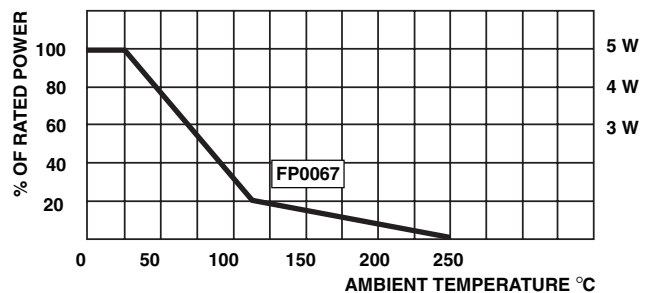
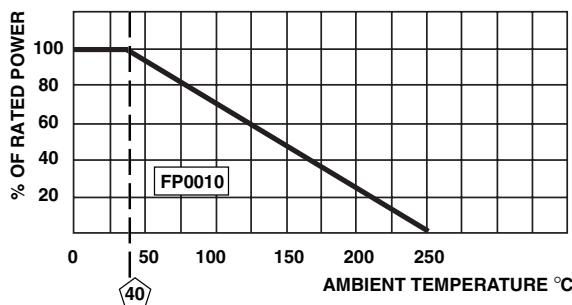
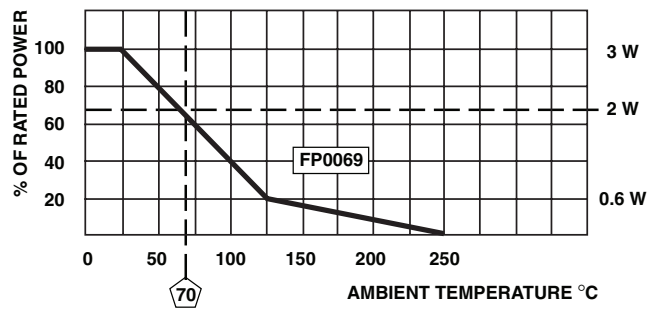
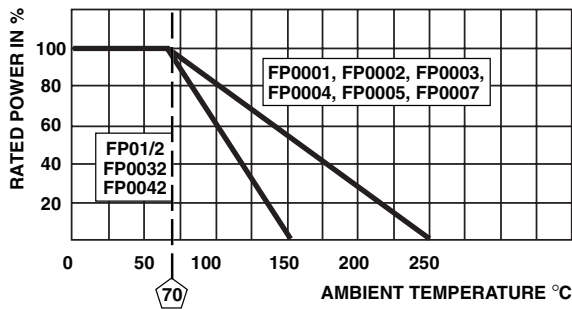


GLOBAL MODEL	DIMENSIONS in inches [millimeters]		
	A	B	D
FP01/2	0.360 ± 0.020 [9.14 ± 0.51] ⁽¹⁾	0.138 + 0.012 - 0.023 [3.51 + 0.31 - 0.58]	0.032 ± 0.002 [0.81 ± 0.05]
FP0001	0.560 ± 0.031 [14.22 ± 0.79]	0.190 + 0.007 - 0.015 [4.83 + 0.18 - 0.38]	0.032 ± 0.002 [0.81 ± 0.05]
FP0032	0.560 ± 0.031 [14.22 ± 0.79]	0.190 + 0.007 - 0.015 [4.83 + 0.18 - 0.38]	0.040 ± 0.002 [1.02 ± 0.05]
FP0002	0.687 ± 0.031 [17.45 ± 0.79]	0.300 ± 0.020 [7.62 ± 0.51]	0.032 ± 0.002 [0.81 ± 0.05]
FP0042	0.687 ± 0.031 [17.45 ± 0.79]	0.300 ± 0.020 [7.62 ± 0.51]	0.045 ± 0.002 [1.14 ± 0.05]
FP0003	0.900 ± 0.031 [22.86 ± 0.79]	0.300 ± 0.020 [7.62 ± 0.51]	0.032 ± 0.002 [0.81 ± 0.05]
FP0004	1.530 ± 0.035 [38.86 ± 0.89]	0.300 ± 0.020 [7.62 ± 0.51]	0.032 ± 0.002 [0.81 ± 0.05]
FP0005	1.710 ± 0.035 [43.43 ± 0.89]	0.300 ± 0.020 [7.62 ± 0.51]	0.032 ± 0.002 [0.81 ± 0.05]
FP0007	2.040 ± 0.035 [51.82 ± 0.89]	0.300 ± 0.020 [7.62 ± 0.51]	0.032 ± 0.002 [0.81 ± 0.05]
FP0010	2.040 ± 0.035 [51.82 ± 0.89]	0.300 ± 0.020 [7.62 ± 0.51]	0.032 ± 0.002 [0.81 ± 0.05]
FP0067	0.900 ± 0.031 [22.86 ± 0.79]	0.300 ± 0.020 [7.62 ± 0.51]	0.032 ± 0.002 [0.81 ± 0.05]
FP0069	0.516 ± 0.021 [13.11 ± 0.53]	0.225 ± 0.012 [5.72 ± 0.31]	0.032 ± 0.002 [0.81 ± 0.05]

Note:

⁽¹⁾ Clean lead to clean lead dimensions on FP1/2 are 0.347" [11.10 mm] maximum.

DERATING



SPEC CODES			
GLOBAL MODEL	SPEC	RESISTOR TOLERANCE	DESCRIPTION
FP01/2	5605	1, 2, 5, 10	Color banded, 4 or 5 bands depending on tolerance
	5610	1, 2, 5, 10	Alphanumeric marking
FP0001	6200	2, 5, 10	Color banded, 4 bands
	6201	1	Color banded, 5 bands
FP0032	6601	1	Color banded, 5 bands
	6602	2, 5, 10	Color banded, 4 bands
FP0002	9251	1, 2, 5, 10	Alphanumeric marking
FP0042	9201	1	Color banded, 5 bands
	9202	2, 5, 10	Color banded, 4 bands
FP0003	9300	1, 2, 5, 10	Alphanumeric marking
	9320	2, 5, 10	Color banded, 4 bands
	9330	1	Color banded, 5 bands
FP0004	9400	1, 2, 5, 10	Alphanumeric marking
FP0005	9500	1, 2, 5, 10	Alphanumeric marking
FP0007	9700	1, 2, 5, 10	Alphanumeric marking
FP0010	9800	1, 2, 5, 10	Alphanumeric marking
FP0067	9550	1, 2, 5, 10	Alphanumeric marking
FP0069	7500	1, 2, 5, 10	Alphanumeric marking
	7536	2, 5, 10	Color banded, 4 bands
	7538	1	Color banded, 5 bands

MARKING			
- DALE	- Value	- Tolerance	- Model and case size (Date and source code included on some styles)
<p>± 1 % tolerance parts are marked with 5 color bands. 5 bands, EIA Standard RS196.</p>		<p>± 2 %, ± 5 % and ± 10 % tolerance parts are marked with 4 color bands. 4 band commercial, EIA Standard.</p>	
<p>First significant figure Second significant figure</p> <p>Third significant figure Multiplier Tolerance, 1-1/2 times size</p>		<p>First significant figure Second significant figure</p> <p>Multiplier Tolerance</p>	



PERFORMANCE												
TEST	MAXIMUM $\Delta R \pm \%$											
	FP01/2	FP0001	FP0032	FP0002	FP0042	FP0003	FP0004	FP0005	FP0007	FP0010	FP0067	FP0069
Short Time Overload	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Low Temperature Operation	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.25	0.25
Moisture Resistance	1.0	1.5	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Shock	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vibration	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Temperature Cycle	1.0	1.0	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5
Load Life (1000 h Rated Conditions)	1.0	2.0	2.0	5.0	2.0	5.0	5.0	5.0	5.0	5.0	5.0	3.0
Terminal Strength	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dielectric Withstanding Voltage	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.25	0.25
Effect Solder Heat	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.25	0.25

Metal Film Resistors, Pulse Withstanding Protective



FEATURES

- Special Vishay Dale design provides lightning withstand characteristics along with resistor functionality
- A thicker tin oxide power film system provides lightning surge absorption capabilities
- Higher turns ratio and glass substrate provide sharper fusing characteristic than the standard flameproof product line
- Protect against a variety of electrical hazards which can change or destroy sensitive electronic equipment including high energy voltage surges caused by power line anomalies (direct power crosses or inductively coupled effects) and other momentary overvoltages
- Lead (Pb)-free version is RoHS compliant



RoHS* COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS					
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{70\text{ }^\circ\text{C}}$ W	RESISTANCE RANGE Ω	STANDARD TOLERANCE %	CUTOFF VALUE
FP1/2P	FP1/2P	0.5	10R - 1M	1, 2, 5	2K00
FP001P	FP1P	1	10R - 1M	1, 2, 5	1K00
FP002P	FP2P	2	9R - 1M5	1, 2, 5	300R
FP003P	FP3P	3	9R - 1M	1, 2, 5	250R
FP069P	FP69P	2	2R6 - 1M	1, 2, 5	400R

Notes:

- Pulse withstanding capabilities are value dependent.
- Value above the cutoff value, shown above, will meet all the surge test requirements shown on next page.

MARKING	
	- DALE - Value - Tolerance - Style and case size - Date code (year/week)

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: FP002P1K00F9256B8 (preferred part numbering format)

F	P	0	0	2	P	1	K	0	0	F	9	2	5	6	B	8
GLOBAL MODEL (see Standard Electrical Specifications Table)		RESISTANCE VALUE R = Decimal K = Thousand M = Million 10R0 = 10 Ω 1K30 = 1.3 k Ω 1M00 = 1.0 M Ω				TOLERANCE CODE F = $\pm 1\%$ G = $\pm 2\%$ J = $\pm 5\%$			SPEC CODES 5555 = FP1/2P 6206 = FP001P 9256 = FP002P 9303 = FP003P 7532 = FP069P			PACKAGING ⁽¹⁾ EK = Lead (Pb)-free, Bulk EA = Lead (Pb)-free, T/R B8 = Tin/Lead, Bulk CH = Tin/Lead, T/R (750 pieces) CJ = Tin/Lead, T/R (1000 pieces)				

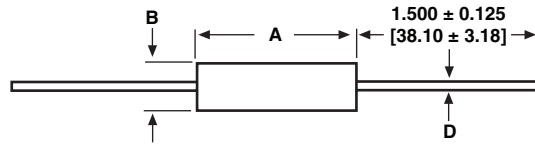
Historical Part Number: FP2P 1K00 1% B8 (will continue to be accepted)

FP2P	1K00	1%	B8
HISTORICAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING

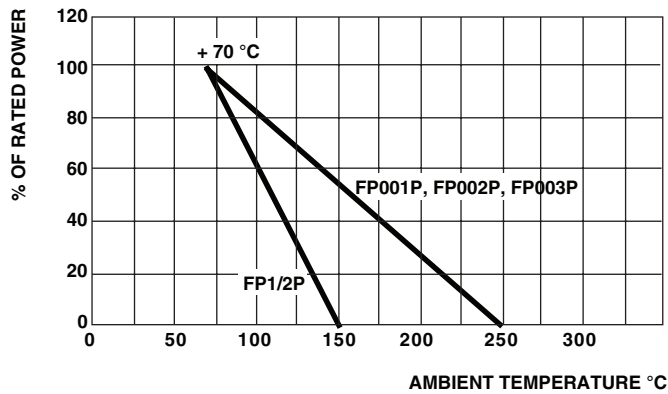
Note:

- ⁽¹⁾ Some packaging codes are model specific.
* Pb containing terminations are not RoHS compliant, exemptions may apply

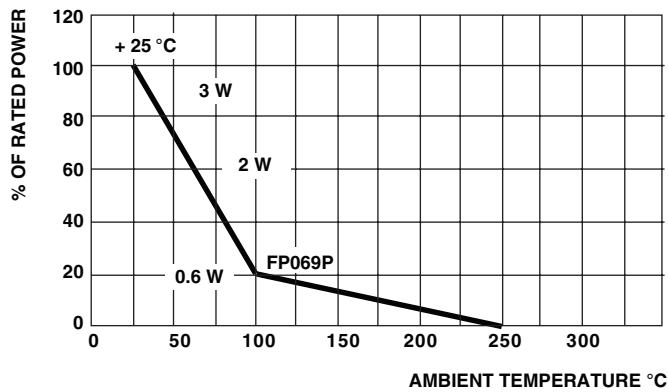
DIMENSIONS in inches [millimeters]



GLOBAL MODEL	DIMENSIONS in inches [millimeters]		
	A	B	D
FP1/2P	0.360 ± 0.020 [9.14 ± 0.51]	0.138 + 0.012 - 0.023 [3.51 + 0.31 - 0.58]	0.032 ± 0.002 [0.81 ± 0.05]
FP001P	0.560 ± 0.031 [14.22 ± 0.79]	0.190 + 0.007 - 0.015 [4.83 + 0.18 - 0.38]	0.032 ± 0.002 [0.81 ± 0.05]
FP002P	0.687 ± 0.031 [17.45 ± 0.79]	0.300 ± 0.020 [7.62 ± 0.51]	0.032 ± 0.002 [0.81 ± 0.05]
FP003P	0.900 ± 0.055 [22.86 ± 1.40]	0.300 ± 0.020 [7.62 ± 0.51]	0.032 ± 0.002 [0.81 ± 0.05]
FP069P	0.516 ± 0.021 [13.11 ± 0.53]	0.225 ± 0.012 [5.72 ± 0.31]	0.032 ± 0.002 [0.81 ± 0.05]



DERATING



DERATING

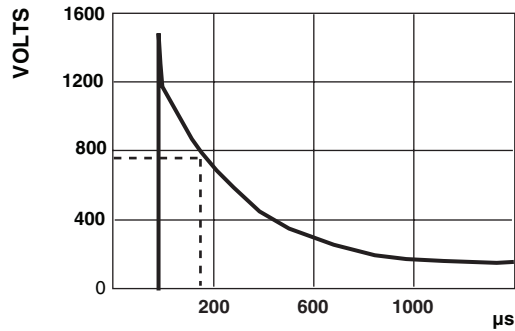


LIGHTNING PULSE WAVE FORMS

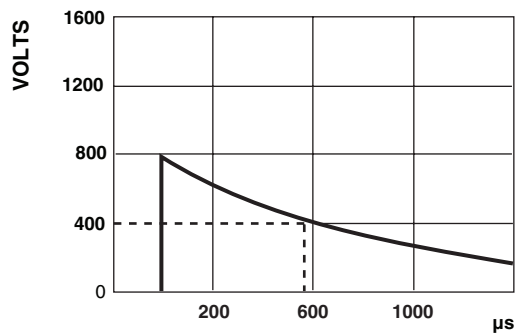
Lightning pulse wave forms are defined by three numbers:

- Maximum time to reach peak voltage level (typically 10 μ s).
- Minimum time for voltage to decrease to half value.
- The peak voltage level.

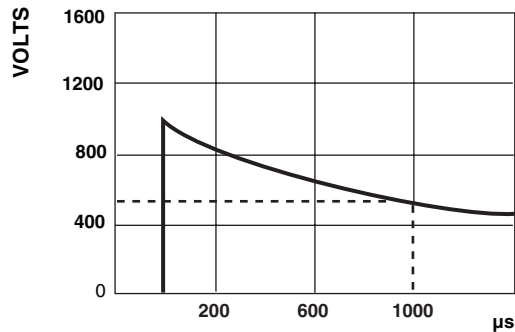
Three examples are shown below.



10 by 160 to 1500 V FCC - Longitudinal Surge

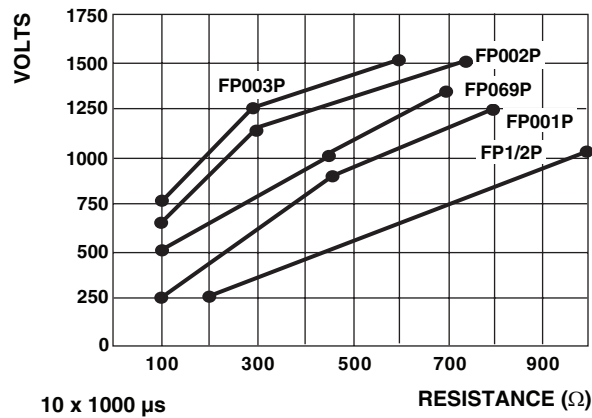
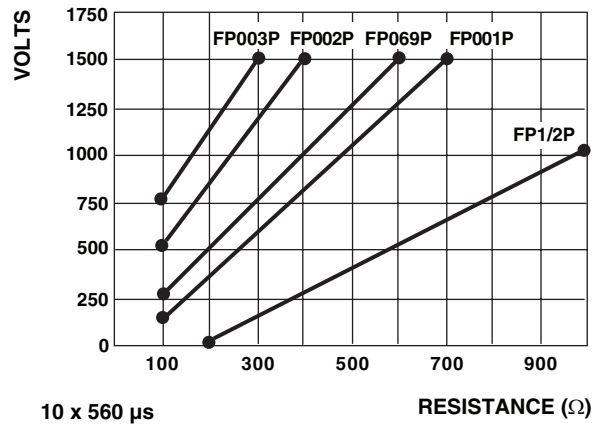
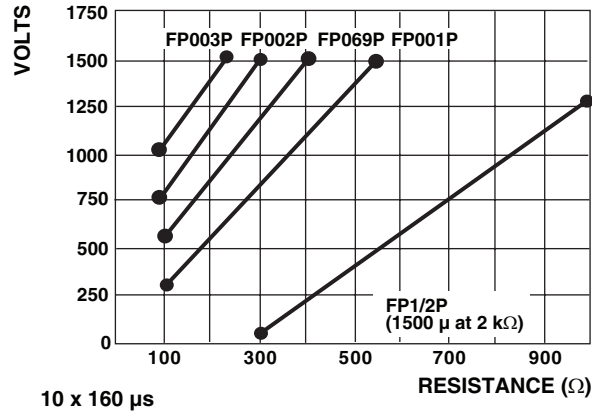


10 by 560 to 800 V FCC - Metallic Surge



10 by 1000 to 1000 V REA - Current Surge

These graphs show the relationship value and pulse withstanding voltage for FP1/2P thru FP003P using a 1.0 % resistance shift after 10 pulses as the figure of merit. The stable operating region of each package is on the right side of the appropriate line.



Metal Film Resistor, Power Type, Miniature



FEATURES

- Metal film resistor with high power rating
- Stable film structure on special ceramic
- Good thermal distribution
- Lead (Pb)-free solder contacts on Ni barrier layer
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- For applications in power electronics



STANDARD ELECTRICAL SPECIFICATIONS						
MODEL	POWER RATING $P_{70\text{ }^\circ\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX. V \cong	TEMP. COEF. ppm/K	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
HMA0207	0.8	500	± 50	± 1	4R7 - 511K	24 - 96

Notes:

- Coating - green
- Further values on request
- Marking: See appropriate catalog or web page
- Additional orange color dot at the beginning of the code

TECHNICAL SPECIFICATIONS		
PARAMETER	UNIT	HMA0207
Rated Dissipation at 70 °C	W	0.8
Limiting Element Voltage ⁽¹⁾	V \cong	≤ 500
Insulation Voltage (1 Min)	V _{eff}	> 700
Thermal Resistance	K/W	130
Insulation Resistance	Ω	$\geq 10^{11}$
Category Temperature Range	$^\circ\text{C}$	- 55 to + 175
Terminal Strength, Axial	N	> 50
Failure Rate	$10^{-9}/\text{h}$	< 5
Weight	g	0.22

Note:

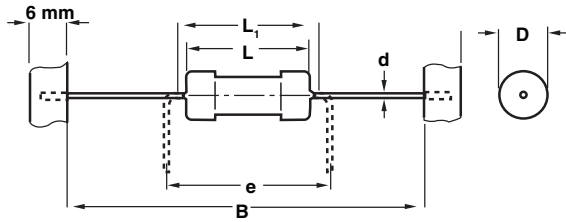
⁽¹⁾ Rated voltage $\sqrt{P \times R}$

PART NUMBER AND PRODUCT DESCRIPTION							
PART NUMBER: HMA02070C1801FD50							
H	M	A	0	2	0	7	0
C	1	8	0	1	F	D	5
MODEL	SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING ⁽²⁾	SPECIAL
HMA	0207	0 = Neutral	C = ± 50 ppm/K	3 digit value 1 digit multiplier MULTIPLIER 7 = $\times 10^{-3}$ 2 = $\times 10^2$ 8 = $\times 10^{-2}$ 3 = $\times 10^3$ 9 = $\times 10^{-1}$ 4 = $\times 10^4$ 0 = $\times 10^0$ 5 = $\times 10^5$ 1 = $\times 10^1$ 6 = $\times 10^6$	F = ± 1 %	12 = A2 (G26) 22 = A2 (G53) 25 = A5 D5 = R5	Up to 2 digits 00 = Standard
PRODUCT DESCRIPTION: HMA0207 50 1K8 1% R5							
HMA0207	50	1K8	1 %	R5			
MODEL	TC	RESISTANCE VALUE	TOLERANCE	PACKAGING ⁽²⁾			
HMA0207	± 50 ppm/K	49K9 = 49.9 k Ω 51R1 = 51.1 Ω	± 1 %	A2 (G26) A2 (G53) A5 R5			

Note:

⁽²⁾ Please refer to table PACKAGING, see next page.

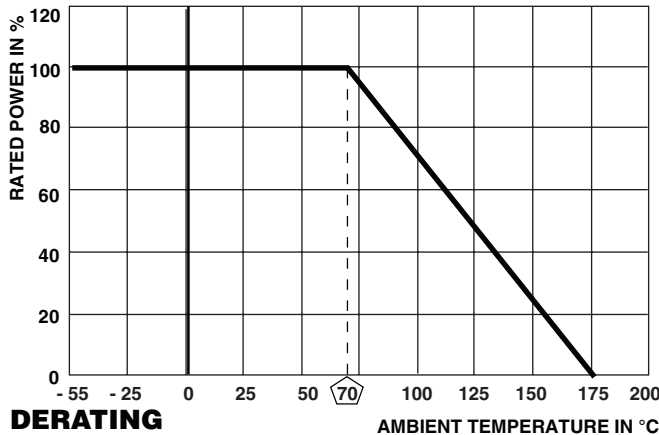
DIMENSIONS



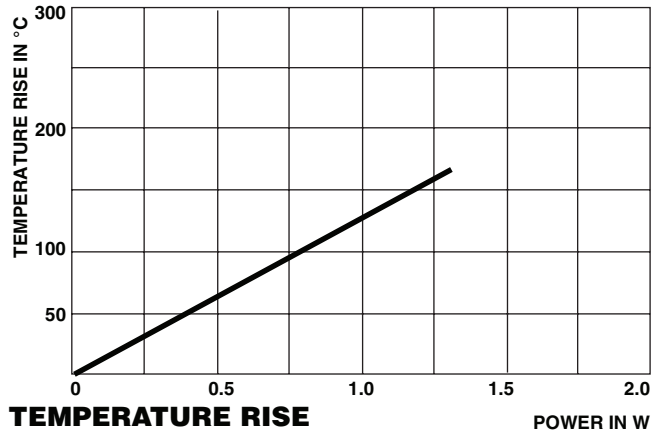
MODEL	Dimensions [in millimeters]					
	D _{max.}	L	L _{1 max.}	B	d	e
HMA0207	2.5 ^{-0.3}	6.3 ^{-0.5}	7.5	53 ± 1	0.6	7.5

Notes:

- Taping in acc. with IEC60286-1
- D and L measured in acc. with IEC60294
- d according to IEC60301



DERATING



TEMPERATURE RISE

PACKAGING						
MODEL	REEL			BOX		
	PIECES/REEL	CODE	MIN QTY ORDER PACKAGING UNITS	PIECES/BOX	CODE	MIN QTY ORDER PACKAGING UNITS
HMA0207	5000	R5	1	5000 2000	A5 A2	1 2

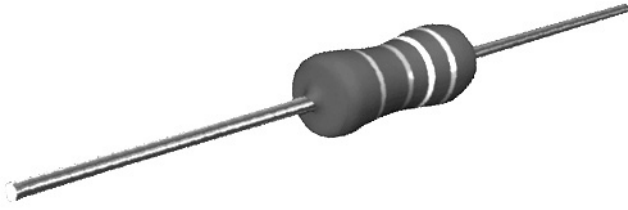
PERFORMANCE		
TEST	CONDITIONS OF TEST	REQUIREMENTS ⁽¹⁾
Endurance Test at 70 °C IEC 60115-1 4.25.1	1000 h at 70 °C, 1.5 h ON, 0.5 h OFF	≤ ± 1.5 %
Endurance at UCT IEC 60115-1 4.25.3	1000 h at 155 °C without load	≤ ± 1.5 %
Overload Test IEC 60115-1 4.13	Short time overload 5 s at 2.5 x rated voltage or ≤ ± twice the limiting element voltage	≤ ± 0.25 %
Thermal Shock IEC 60115-1 4.19, IEC 60068-2-14	Rapid change between upper and lower category temperature	≤ ± 0.1 %
Climatic Sequence IEC 60115-1 4.23	Dry heat, damp heat cycle, cold, low air pressure	≤ ± 0.5 %
Damp Heat Steady State IEC 60115-1 4.24, IEC 60068-2-3	56 days at 40 °C and 93 % relative humidity	≤ ± 0.5 %
Resistance to Soldering Heat IEC 60115-1 4.18, IEC 60068-2-20	10 s at 260 °C solder bath temperature	≤ ± 0.25 %
Robustness of Terminations IEC 60115-1 4.16	Tensile, bending and torsion	≤ ± 0.1 %
Vibration IEC 60115-1 4.22	0.75 mm or 10 g, 10 Hz to 500 Hz 6 h	≤ ± 0.1 %

Note:

⁽¹⁾ For a resistance range of 10R to 511K

APPLICABLE SPECIFICATIONS
• CECC 40000/EN 140000/IEC 60115-1

Power Metal Film Resistors



DESCRIPTION

A homogeneous 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 or copper-clad iron are welded to the end-caps. The resistors are coated with a red, nonflammable lacquer which provides electrical, mechanical and climatic protection. This coating is not resistant to aggressive fluxes. The encapsulation is resistant to all cleaning solvents in accordance with "MIL-STD-202E, method 215", and "IEC 60068-2-45".

FEATURES

- High power in small packages (1 W/0207 size to 3 W/0617 size)
- Different lead materials for different applications
- Defined interruption behaviour
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- All general purpose power applications

TECHNICAL SPECIFICATIONS

DESCRIPTION	VALUE				
	PR01	PR02		PR03	
		Cu-lead	FeCu-lead	Cu-lead	FeCu-lead
Resistance Range ⁽²⁾	0.22 Ω to 1 MΩ	0.33 Ω to 1 MΩ	1 Ω to 1 MΩ	0.68 Ω to 1 MΩ	1 Ω to 1 MΩ
Resistance Tolerance and Series	± 1 % (E24, E96 series); ± 5 % (E24 series) ⁽¹⁾				
Maximum Dissipation at $T_{amb} = 70\text{ °C}$:					
$R < 1\ \Omega$	0.6 W	1.2 W	-	1.6 W	-
$1\ \Omega \leq R$	1 W	2 W	1.3 W	3 W	2.5 W
Thermal Resistance (R_{th})	135 K/W	75 K/W	115 K/W	60 K/W	75 K/W
Temperature Coefficient	$\leq \pm 250 \times 10^{-6}/K$				
Maximum Permissible Voltage (DC or RMS)	350 V	500 V		750 V	
Basic Specifications	IEC 60115-1 and 60115-4				
Climatic Category (IEC 60068)	55/155/56				
Stability After:					
Load	ΔR max.: ± (5 % R + 0.1 Ω)				
Climatic Tests	ΔR max.: ± (3 % R + 0.1 Ω)				
Soldering	ΔR max.: ± (1 % R + 0.05 Ω)				

Notes:

- ⁽¹⁾ 1 % tolerance is available for R_n -range from 1 R upwards
⁽²⁾ Ohmic values (other than resistance range) are available on request
 • R value is measured with probe distance of 24 ± 1 mm using 4-terminal method

12NC INFORMATION

The resistors have a 12-digit numeric code starting with 23
 For 5 % tolerance:

- The next 7 digits indicate the resistor type and packing
- The remaining 3 digits indicate the resistance value:
 - The first 2 digits indicate the resistance value
 - The last digit indicates the resistance decade

For 1 % tolerance:

- The next 6 digits indicate the resistor type and packing
- The remaining 4 digits indicate the resistance value:
 - The first 3 digits indicate the resistance value
 - The last digit indicates the resistance decade

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
0.22 to 0.91 Ω	7
1 to 9.76 Ω	8
10 to 97.6 Ω	9
100 to 976 Ω	1
1 to 9.76 kΩ	2
10 to 97.6 kΩ	3
100 to 976 kΩ	4
1 MΩ	5

12NC Example

The 12NC for resistor type PR02 with Cu leads and a value of 750 Ω with 5 % tolerance, supplied on a bandolier of 1000 units in ammopack, is: 2306 198 53751.



12NC - Resistor Type and Packaging ⁽¹⁾								
TYPE	LEAD Ø mm	TOL (%)	ORDERING CODE 23.. (BANDOLIER)					
			AMMOPACK				REEL	
			RADIAL TAPED		STRAIGHT LEADS			
			4000 units	3000 units	52 mm 5000 units	52 mm 1000 units	63 mm 500 units	52 mm 5000 units
PR01	Cu 0.6	1	-	-	22 196 1...	06 191 2...	-	06 191 5...
		5	06 197 03...	-	22 193 14...	06 197 53...	-	06 197 23...
PR02	Cu 0.8	1	-	22 197 2...	-	22 197 1...	-	06 192 5...
		5	-	06 198 03...	-	06 198 53...	-	06 198 23...
PR03	Cu 0.8	5	-	-	-	-	22 195 14...	-
		1	-	-	-	-	06 199 6...	-
		5	-	-	-	-	22 195 54...	-

Notes:

- ⁽¹⁾ Other packaging versions are available on request
- Preferred types in bold

12NC - Resistor Type and Packaging						
TYPE	LEAD Ø mm	TOL (%)	ORDERING CODE 23.. (LOOSE IN BOX)			
			DOUBLE KINK			
			PITCH = 17.8 mm	PITCH = 25.4 mm	PITCH ⁽²⁾ ⁽³⁾ ⁽⁴⁾	
			1000 units	500 units	1000 units	500 units
PR01	Cu 0.6	5	22 193 03...	-	-	-
	FeCu 0.6	5	22 193 43...	-	22 193 53... ⁽²⁾	-
PR02	Cu 0.8	5	22 194 23...	-	-	-
	FeCu 0.6	5	22 194 83...	-	-	-
	FeCu 0.8	5	-	-	22 194 63... ⁽³⁾	-
PR03	Cu 0.8	5	-	22 195 23...	-	-
	FeCu 0.6	5	-	22 195 83...	-	-
	FeCu 0.8	5	-	-	-	22 195 63... ⁽⁴⁾

Notes:

- ⁽²⁾ PR01 pitch 12.5 mm
- ⁽³⁾ PR02 pitch 15.0 mm
- ⁽⁴⁾ PR03 pitch 20.0 mm, with reversed kinking direction as opposed to the drawing for the type with double kink figure
- Preferred types in bold

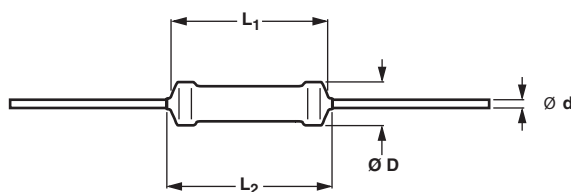
PART NUMBER AND PRODUCT DESCRIPTION																									
PART NUMBER: PR02000201001JA100																									
<table border="1" style="width:100%; text-align:center;"> <tr> <td>P</td><td>R</td><td>0</td><td>2</td><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>J</td><td>A</td><td>1</td><td>0</td><td>0</td> </tr> </table>								P	R	0	2	0	0	0	2	0	1	0	0	1	J	A	1	0	0
P	R	0	2	0	0	0	2	0	1	0	0	1	J	A	1	0	0								
MODEL/SIZE	SPECIAL CHARACTE	WIRE TYPES	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING ⁽¹⁾	SPECIAL																		
PR0100 PR0200 PR0300	0 = Neutral Z = Value overflow (Special)	1 = Cu 0.6 2 = Cu 0.8 3 = FeCu 0.6 4 = FeCu 0.8	0 = Standard	3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 2 = *10 ² 8 = *10 ⁻² 3 = *10 ³ 9 = *10 ⁻¹ 4 = *10 ⁴ 0 = *10 ⁰ 5 = *10 ⁵ 1 = *10 ¹	F = ± 1 % J = ± 5 %	N4 R5 N3 L1 A5 DC A1 K1 AC B1 R5 PC	The 2 digits are used for all special parts. 00 = Standard																		
PRODUCT DESCRIPTION: PR02 5 % A1 1K0																									
PR02	5 %	A1	1K0																						
MODEL/SIZE	TOLERANCE	PACKAGING ⁽¹⁾	RESISTANCE VALUE																						
PR01 PR02 PR03	± 1 % ± 5 %	N4 L1 N3 DC A5 K1 A1 B1 AC PC R5	1K0 = 1 kΩ 4K75 = 4.75 kΩ																						

Notes:

- ⁽¹⁾ Please refer to table PACKAGING for details
- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

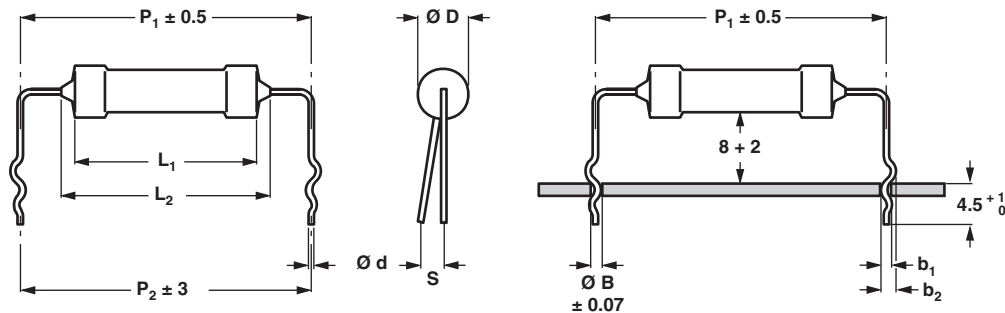
PACKAGING			
CODE	PIECES	DESCRIPTION	MODEL/SIZE
N4	4000	Bandolier in ammpack radial taped	PR01
N3	3000	Bandolier in ammpack radial taped	PR02
A5	5000	Bandolier in ammpack straight leads 52 mm	PR01
A1	1000	Bandolier in ammpack straight leads 52 mm	PR01, PR02
AC	500	Bandolier in ammpack straight leads 63 mm	PR03
R5	5000	Bandolier on reel straight leads 52 mm	PR01, PR02
L1	1000	Loose in box with Double Kink, pitch 17.8 mm	PR01, PR02
DC	500	Loose in box with Double Kink, pitch 25.4 mm	PR03
K1	1000	Loose in box with Double Kink, pitch 12.5 mm	PR01
B1	1000	Loose in box with Double Kink, pitch 15.0 mm	PR02
PC	500	Loose in box with Double Kink, pitch 20.0 mm	PR03

DIMENSIONS



Type with straight leads

DIMENSIONS - straight lead type and relevant physical dimensions; see straight leads outline					
TYPE	Ø D _{max.} (mm)	L ₁ max. (mm)	L ₂ max. (mm)	Ø d (mm)	
				Cu	FeCu
PR01	2.5	6.5	8.5	0.58 ± 0.05	-
PR02	3.9	10.0	12.0	0.78 ± 0.05	0.58 ± 0.05
PR03	5.2	16.7	19.5	0.78 ± 0.05	0.58 ± 0.05



Type with double kink

Dimensions in millimeters

DIMENSIONS - double kink lead type and relevant physical dimensions; see double kinked outline										
TYPE	LEAD STYLE	Ø d (mm)		b ₁ (mm)	b ₂ (mm)	Ø D _{max.} (mm)	P ₁ (mm)	P ₂ (mm)	S _{max.} (mm)	Ø B (mm)
		Cu	FeCu							
PR01	double kink large pitch	0.58 ± 0.05	0.58 ± 0.05	1.10 + 0.25/- 0.20	1.45 + 0.25/- 0.20	2.5	17.8	17.8	2	0.8
	double kink small pitch	-	0.58 ± 0.05	1.10 + 0.25/- 0.20	1.45 + 0.25/- 0.20		12.5	12.5	2	
PR02	double kink large pitch	0.78 ± 0.05	0.58 ± 0.05	1.10 + 0.25/- 0.20	1.45 + 0.25/- 0.20	3.9	17.8	17.8	2	0.8
	double kink small pitch	-	0.78 ± 0.05	1.30 + 0.25/- 0.20	1.65 + 0.25/- 0.20		15.0	15.0	2	
PR03	double kink large pitch	0.78 ± 0.05	0.58 ± 0.05	1.10 + 0.25/- 0.20	1.65 + 0.25/- 0.20	5.2	25.4	25.4	2	1.0
	double kink small pitch	-	0.78 ± 0.05	1.30 + 0.25/- 0.20	2.15 + 0.25/- 0.20		22.0	20.0	2	

MASS PER 100 UNITS	
TYPE	MASS (g)
PR01 Cu 0.6 mm	21.2
PR01 FeCu 0.6 mm	20.7
PR02 Cu 0.8 mm	50.4
PR02 FeCu 0.6 mm	40.6
PR02 FeCu 0.8 mm	49.6
PR03 Cu 0.8 mm	119.2
PR03 FeCu 0.6 mm	107.9
PR03 FeCu 0.8 mm	118.5

MARKING

The nominal resistance and tolerance are marked on the resistor using four colored bands in accordance with IEC publication 60062, "Color codes for fixed resistors".

OUTLINES

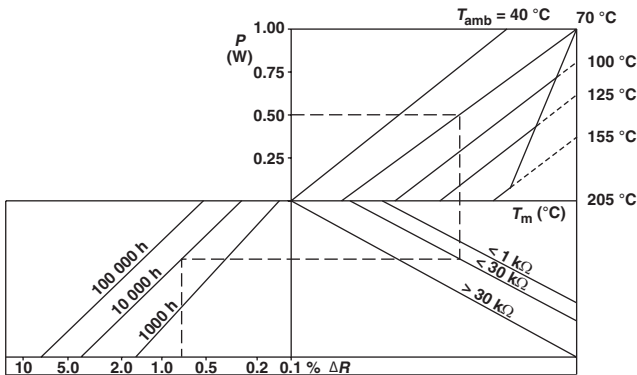
The length of the body (L₁) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation ("IEC publication 60294").

FUNCTIONAL DESCRIPTION

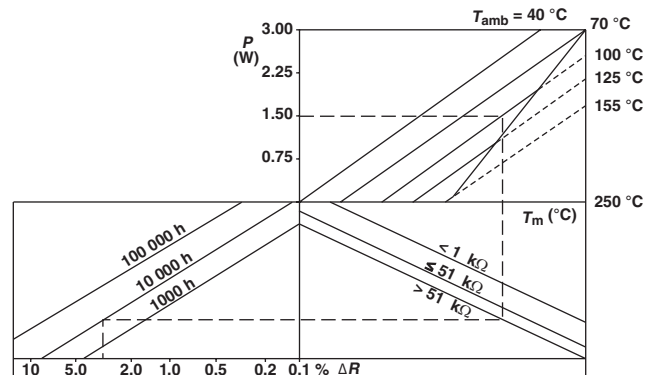
PRODUCT CHARACTERIZATION

Standard values of nominal resistance are taken from the E96/E24 series for resistors with a tolerance of ± 1 % or ± 5 %. The values of the E96/E24 series are in accordance with "IEC publication 60063".

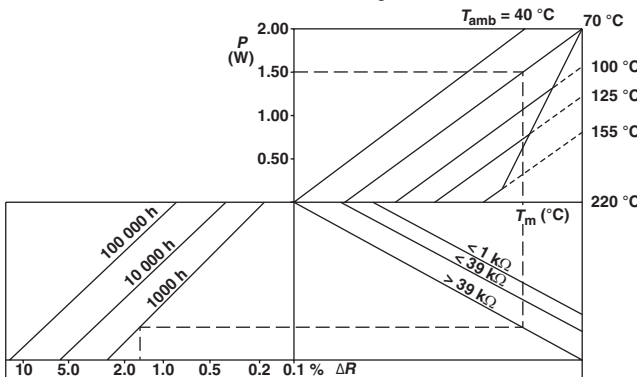
FUNCTIONAL PERFORMANCE



PR01 Drift nomogram



PR03 Drift nomogram



PR02 Drift nomogram

LIMITING VALUES

TYPE	LEAD MATERIAL	RANGE	LIMITING VOLTAGE ⁽¹⁾ (V)	LIMITING POWER (W)
PR01	Cu	$R < 1 \Omega$	350	0.6
		$1 \Omega \leq R$		1.0
PR02	Cu	$R < 1 \Omega$	500	1.2
		$1 \Omega \leq R$		2.0
	FeCu	$1 \Omega \leq R$		1.3
PR03	Cu	$R < 1 \Omega$	750	1.6
		$1 \Omega \leq R$		3.0
	FeCu	$1 \Omega \leq R$		2.5

Note:

- ⁽¹⁾ The maximum voltage that may be continuously applied to the resistor element, see "IEC publication 60115-1".
- The maximum permissible hot-spot temperature is 205 °C for PR01, 220 °C for PR02 and 250 °C for PR03.

MOUNTING

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines.

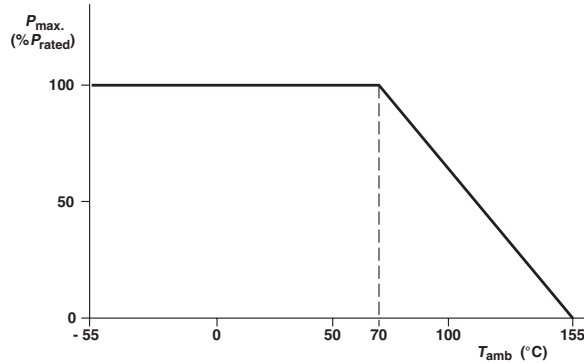
MOUNTING PITCH			
TYPE	LEAD STYLE	PITCH	
		mm	e
PR01	straight leads	12.5 ⁽¹⁾	5 ⁽¹⁾
	radial taped	4.8	2
	double kink large pitch	17.8	7
	double kink small pitch	12.5	5
PR02	straight leads	15.0 ⁽¹⁾	6 ⁽¹⁾
	radial taped	4.8	2
	double kink large pitch	17.8	7
	double kink small pitch	15.0	6
PR03	straight leads	23.0 ⁽¹⁾	9 ⁽¹⁾
	double kink large pitch	25.4	10
	double kink small pitch	20.0	8

Note:

- ⁽¹⁾ Recommended minimum value.

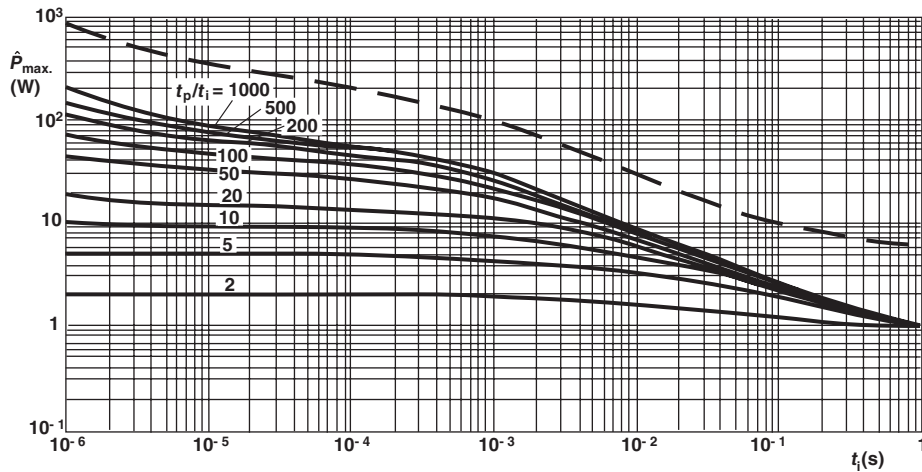


The power that the resistor can dissipate depends on the operating temperature.

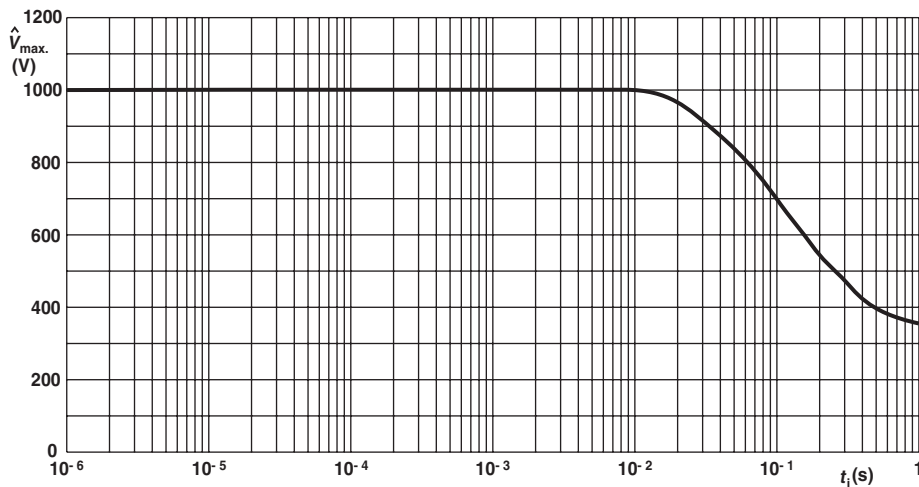


Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb})

Derating

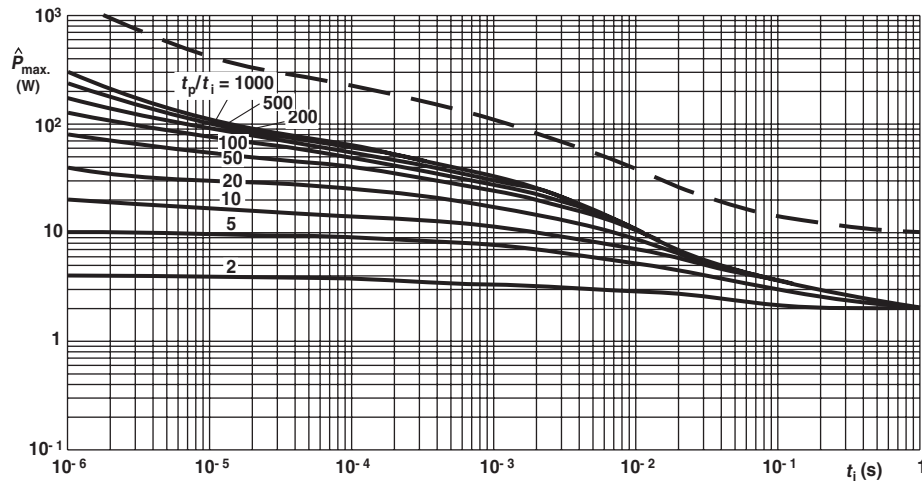


PR01 Pulse on a regular basis; maximum permissible peak pulse power (\hat{P}_{max}) as a function of pulse duration (t_i)

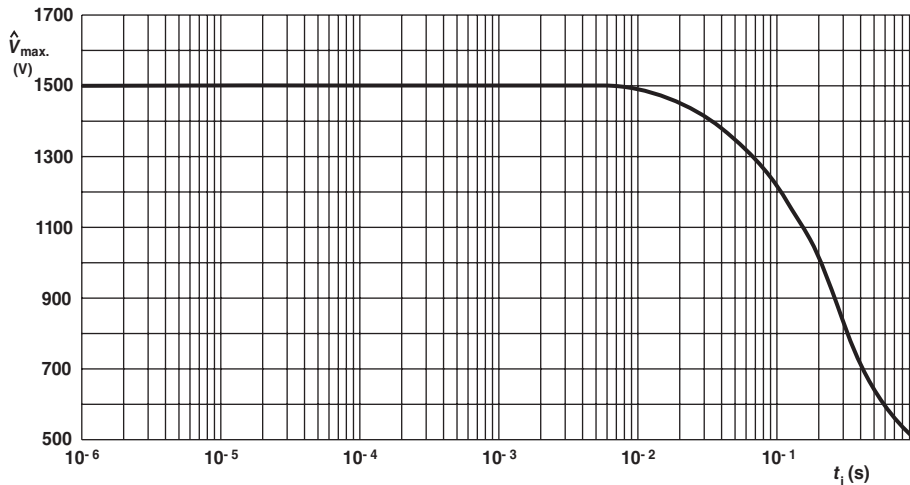


PR01 Pulse on a regular basis; maximum permissible peak pulse voltage (\hat{V}_{max}) as a function of pulse duration (t_i)

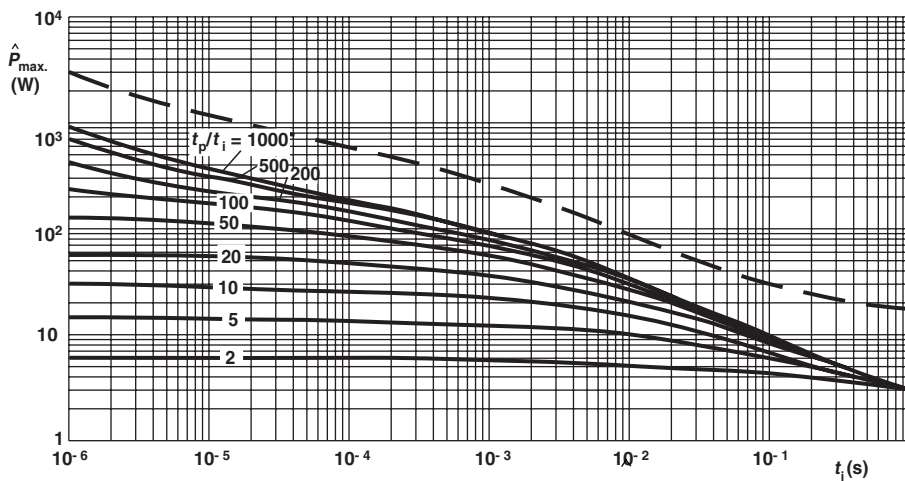
Pulse Loading Capabilities



PR02 Pulse on a regular basis; maximum permissible peak pulse power (\hat{P}_{max}) as a function of pulse duration (t_i)

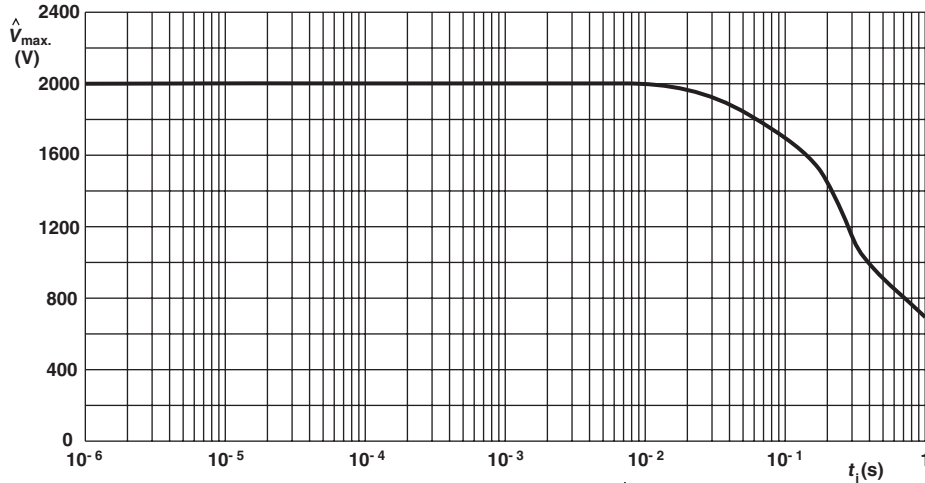


PR02 Pulse on a regular basis; maximum permissible peak pulse voltage (\hat{V}_{max}) as a function of pulse duration (t_i)



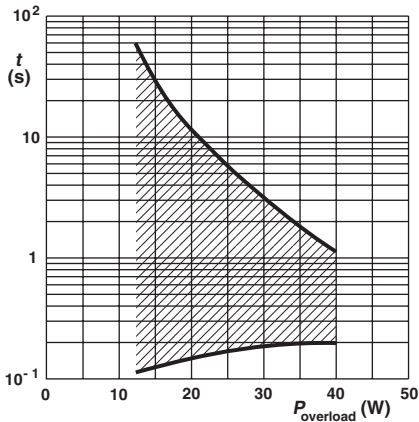
PR03 Pulse on a regular basis; maximum permissible peak pulse power (\hat{P}_{max}) as a function of pulse duration (t_i)

Pulse Loading Capabilities



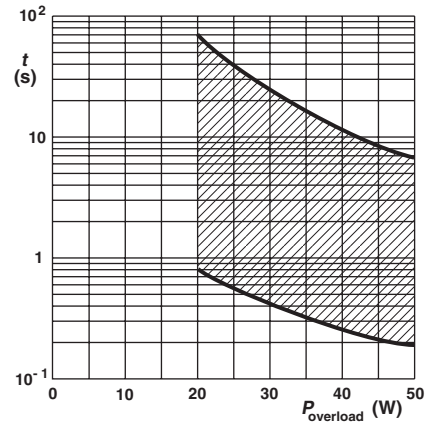
PR03 Pulse on a regular basis; maximum permissible peak pulse voltage (\hat{V}_{max}) as a function of pulse duration (t_i)

Pulse Loading Capabilities



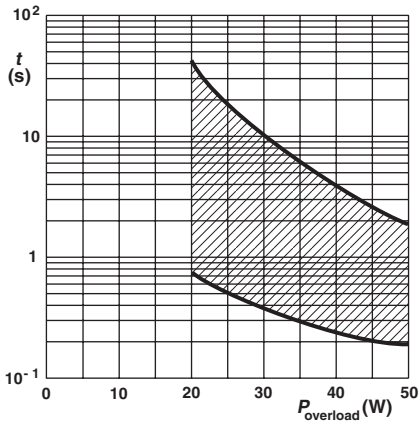
PR01 Time to interruption as a function of overload power for range: $0 R 22 \leq R_n < 1 R$

This graph is based on measured data under constant voltage conditions; the data may deviate according to the applications.



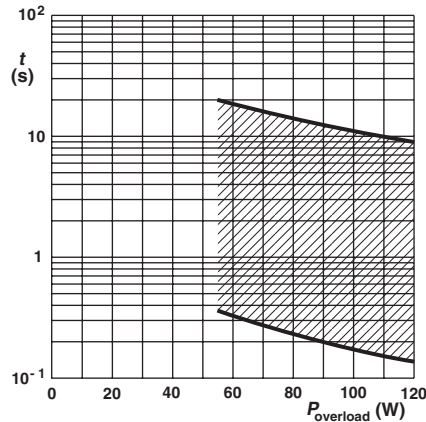
PR01 Time to interruption as a function of overload power for range: $16 R \leq R_n \leq 560 R$

This graph is based on measured data under constant voltage conditions; the data may deviate according to the applications.



PR01 Time to interruption as a function of overload power for range: $1 R \leq R_n \leq 15 R$

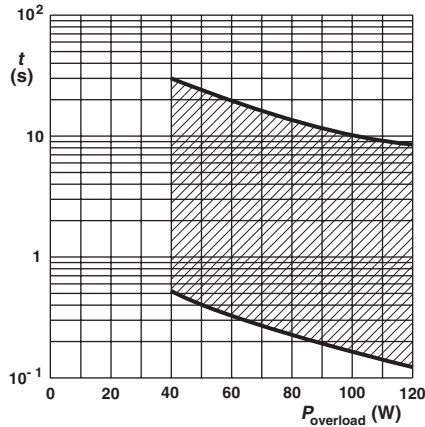
This graph is based on measured data under constant voltage conditions; the data may deviate according to the applications.



PR02 Time to interruption as a function of overload power for range: $0.33 R \leq R_n < 5 R$

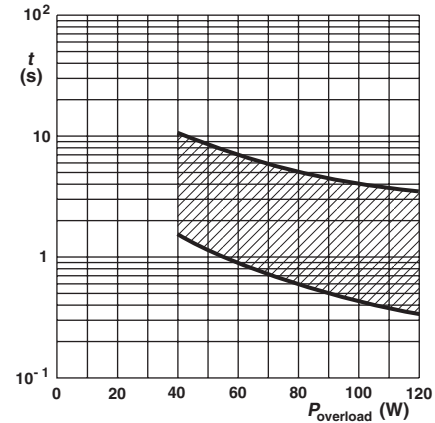
This graph is based on measured data under constant voltage conditions; the data may deviate according to the applications.

Interruption Characteristics



PR02 Time to interruption as a function of overload power for range: $5 R \leq R_n < 68 R$

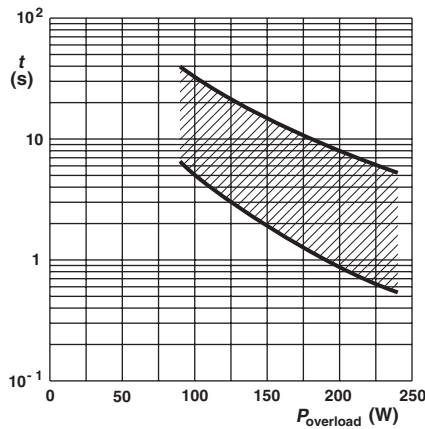
This graph is based on measured data under constant voltage conditions; the data may deviate according to the applications.



PR02 Time to interruption as a function of overload power for range: $68 R \leq R_n \leq 560 R$

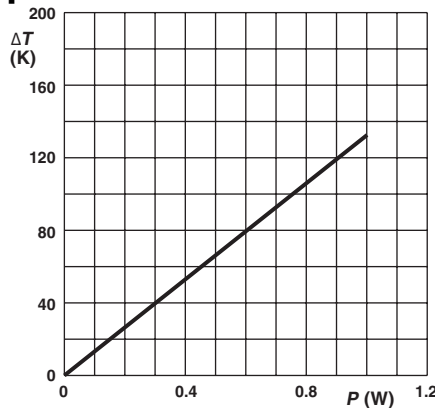
This graph is based on measured data under constant voltage conditions; the data may deviate according to the applications.

Interruption Characteristics



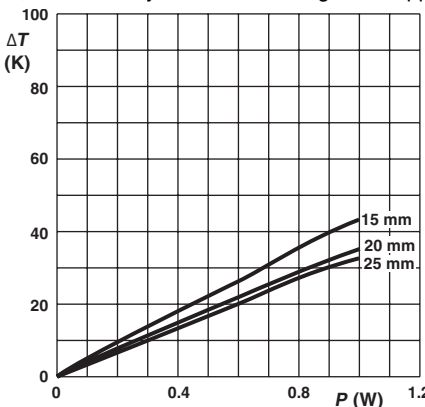
PR03 Time to interruption as a function of overload power for range: $0.68 R \leq R_n \leq 560 R$

This graph is based on measured data under constant voltage conditions; the data may deviate according to the applications.



Ø 0.6 mm Cu-leads

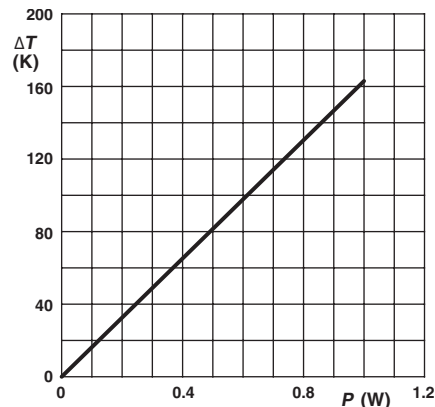
PR01 Hot-spot temperature rise (ΔT) as a function of dissipated power.



Ø 0.6 mm Cu-leads

Minimum distance from resistor body to PCB = 1 mm

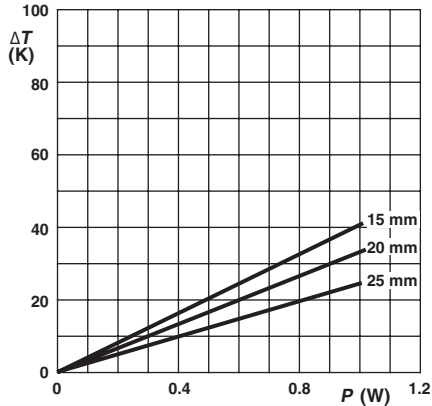
PR01 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



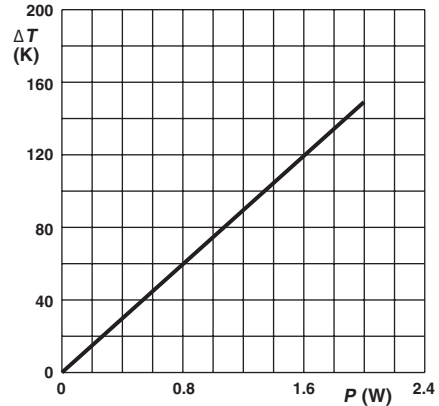
Ø 0.6 mm FeCu-leads

PR01 Hot-spot temperature rise (ΔT) as a function of dissipated power.

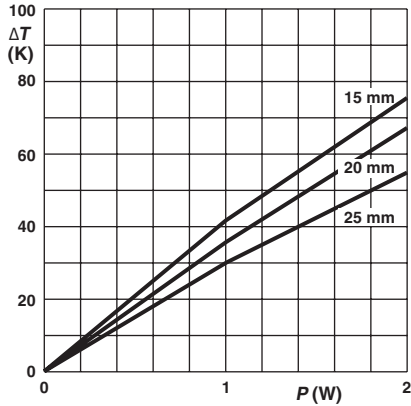
Application Information



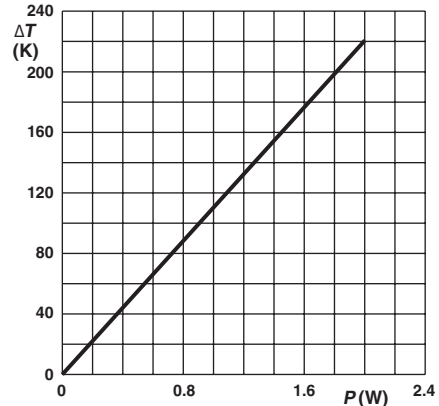
Ø 0.6 mm FeCu-leads
 Minimum distance from resistor body to PCB = 1 mm
PR01 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



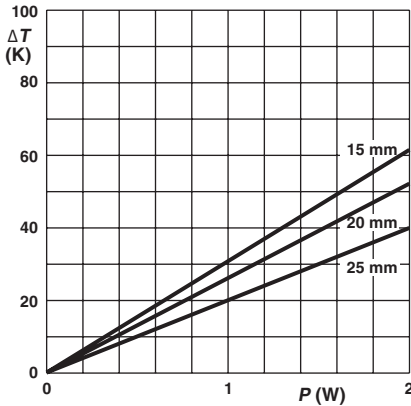
Ø 0.8 mm Cu-leads
PR02 Hot-spot temperature rise (ΔT) as a function of dissipated power.



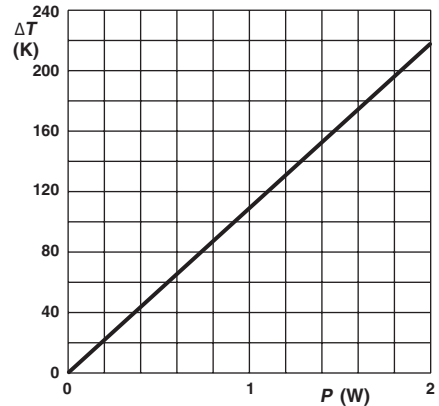
Ø 0.8 mm Cu-leads
 Minimum distance from resistor body to PCB = 1 mm
PR02 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



Ø 0.6 mm FeCu-leads
PR02 Hot-spot temperature rise (ΔT) as a function of dissipated power.

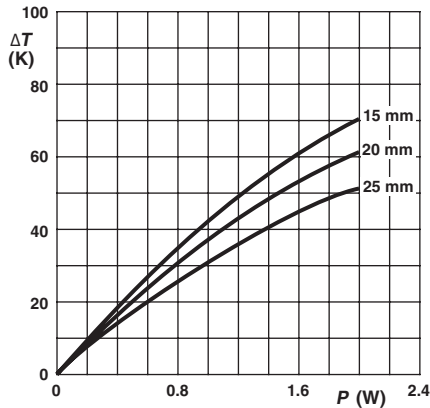


Ø 0.6 mm FeCu-leads
 Minimum distance from resistor body to PCB = 1 mm
PR02 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



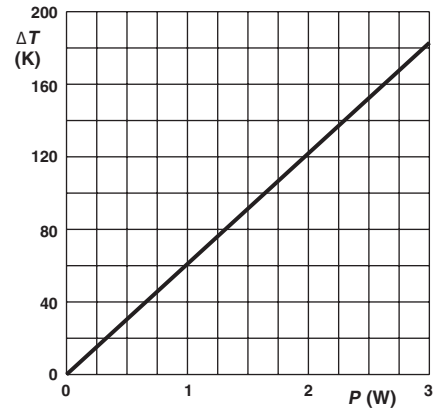
Ø 0.8 mm FeCu-leads
PR02 Hot-spot temperature rise (ΔT) as a function of dissipated power.

Application Information



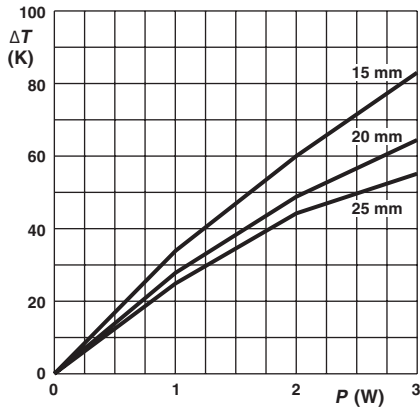
Ø 0.8 mm FeCu-leads
Minimum distance from resistor body to PCB = 1 mm

PR02 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



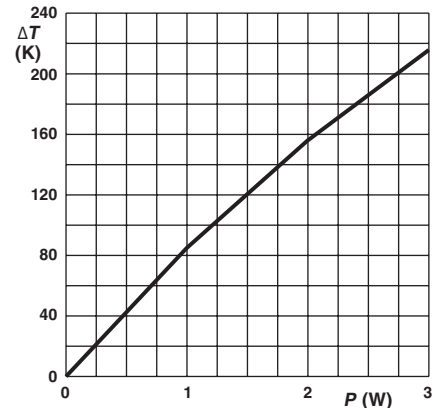
Ø 0.8 mm Cu-leads

PR03 Hot-spot temperature rise (ΔT) as a function of dissipated power.



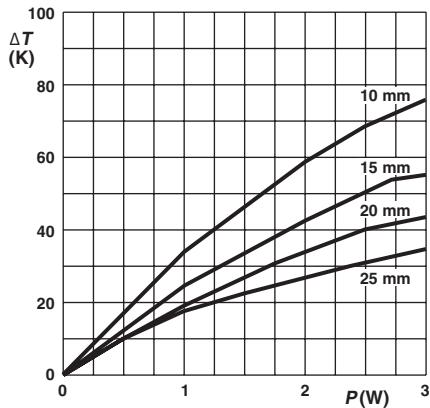
Ø 0.8 mm Cu-leads
Minimum distance from resistor body to PCB = 1 mm

PR03 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



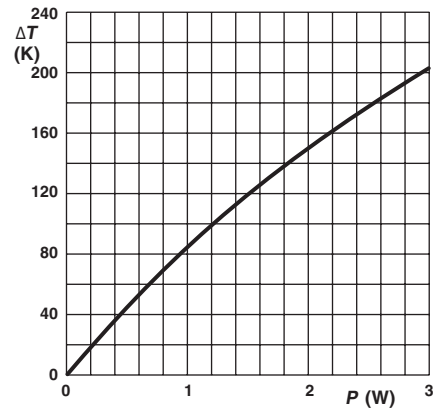
Ø 0.6 mm FeCu-leads

PR03 Hot-spot temperature rise (ΔT) as a function of dissipated power.



Ø 0.6 mm FeCu-leads
Minimum distance from resistor body to PCB = 1 mm

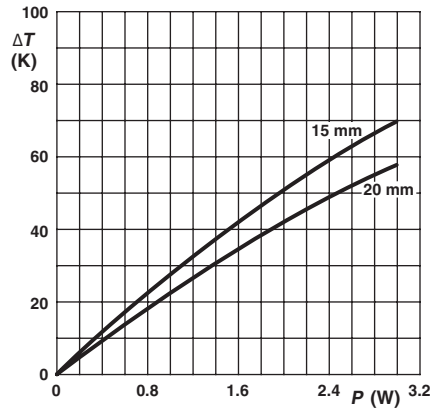
PR03 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



Ø 0.8 mm FeCu-leads

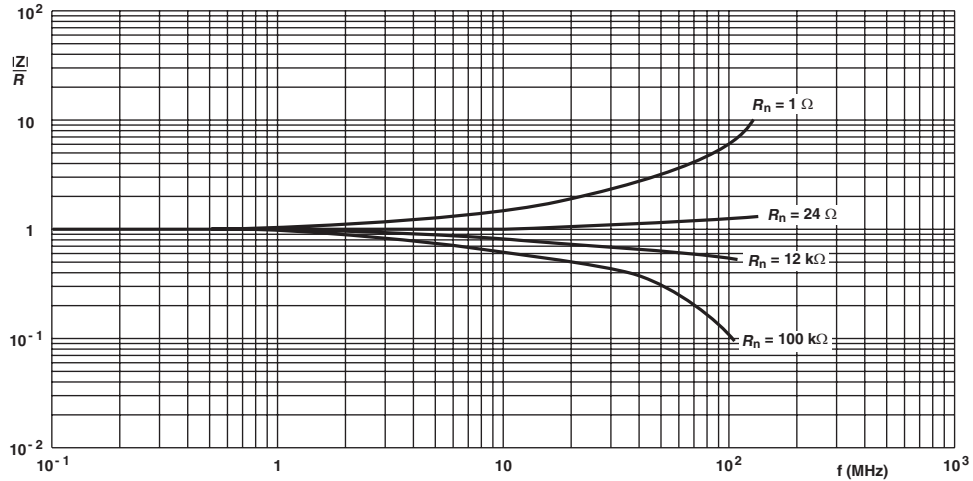
PR03 Hot-spot temperature rise (ΔT) as a function of dissipated power.

Application Information

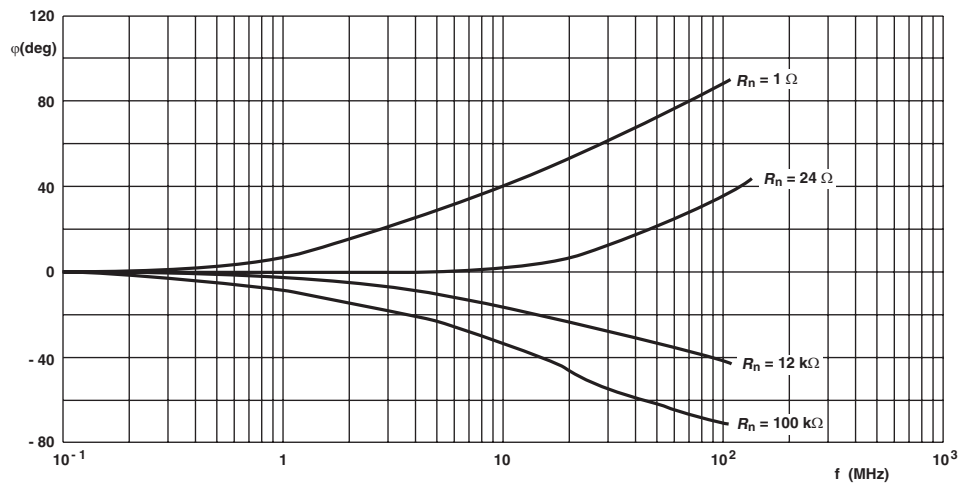


Ø 0.8 mm FeCu-leads
 Minimum distance from resistor body to PCB = 1 mm

PR03 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.

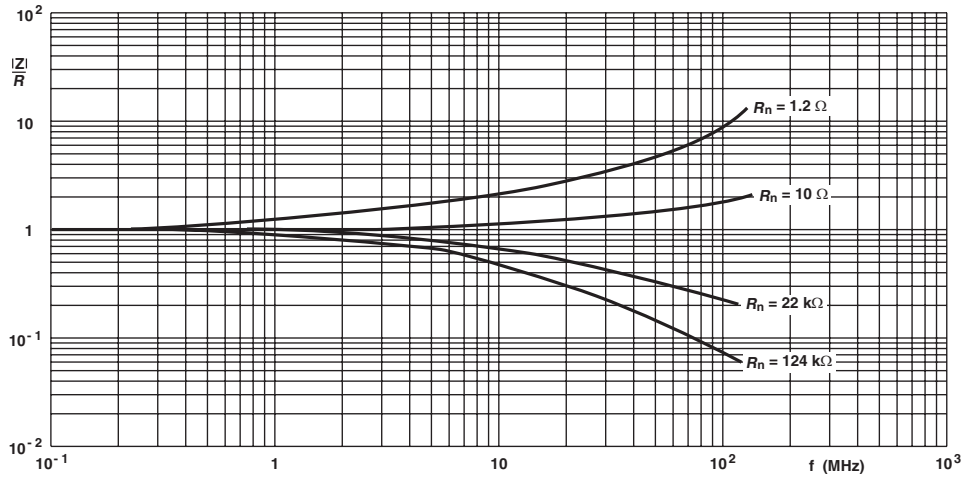


PR01 Impedance as a function of applied frequency

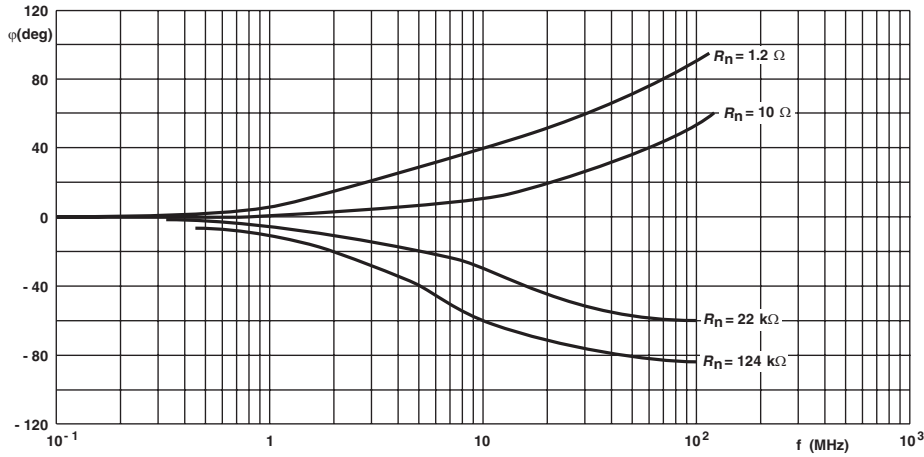


PR01 Phase angle as a function of applied frequency

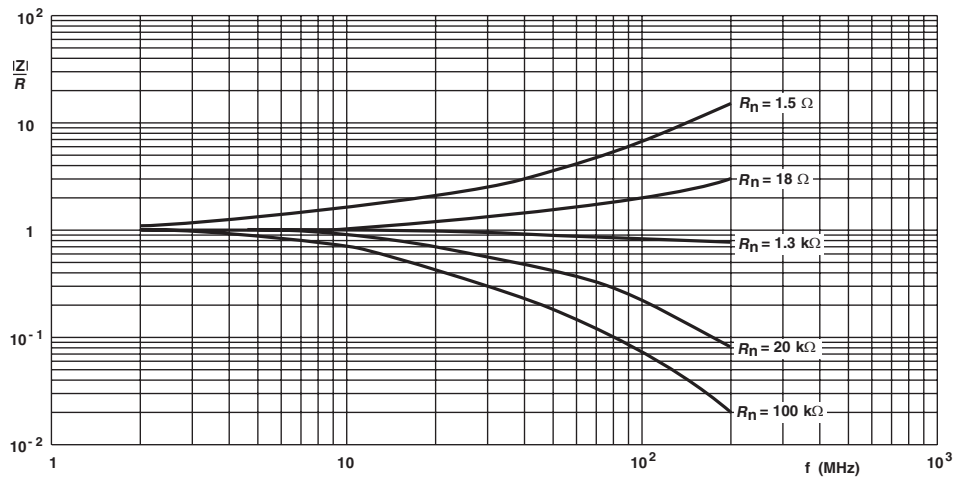
Application Information



PR02 Impedance as a function of applied frequency

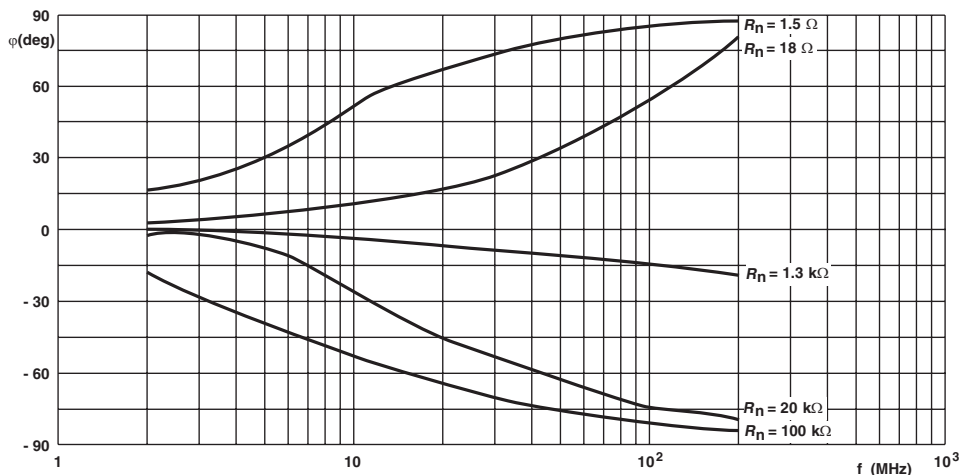


PR02 Phase angle as a function of applied frequency



PR03 Impedance as a function of applied frequency

Application Information



PR03 Phase angle as a function of applied frequency

Application Information

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-1", category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 60068-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and

under standard atmospheric conditions according to "IEC 60068-1", subclause 5.3.

In the Test Procedures and Requirements table, tests and requirements are listed with reference to the relevant clauses of "IEC publications 60115-1 and 60068-2"; a short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying.

All soldering tests are performed with mildly activated flux.

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
TESTS IN ACCORDANCE WITH THE SCHEDULE OF IEC PUBLICATION 60115-1				
4.4.1		visual examination		no holes; clean surface; no damage
4.4.2		dimensions (outline)	gauge (mm)	see Straight and Kinked Dimensions tables
4.5		resistance (refer note on first page for measuring distance)	applied voltage (+ 0/- 10 %): $R < 10 \Omega$: 0.1 V $10 \Omega \leq R < 100 \Omega$: 0.3 V $100 \Omega \leq R < 1 \text{ k}\Omega$: 1 V $1 \text{ k}\Omega \leq R < 10 \text{ k}\Omega$: 3 V $10 \text{ k}\Omega \leq R < 100 \text{ k}\Omega$: 10 V $100 \text{ k}\Omega \leq R < 1 \text{ M}\Omega$: 25 V $R = 1 \text{ M}\Omega$: 50 V	$R - R_{nom}$: max. $\pm 5 \%$
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 3 mm from body	ΔR max.: $\pm (1 \% R + 0.05 \Omega)$
4.29	45 (Xa)	component solvent resistance	isopropyl alcohol or H ₂ O followed by brushing in accordance with "MIL 202 F"	no visual damage
4.17	20 (Ta)	solderability	2 s; 235 °C	good tinning; no damage
4.7		voltage proof on insulation	maximum voltage 500 V _{RMS} during 1 min; metal block method	no breakdown or flashover

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.16 4.16.2 4.16.3 4.16.4	21 (U) 21 (Ua1) 21 (Ub) 21 (Uc)	robustness of terminations: tensile all samples bending half number of samples torsion other half of samples	load 10 N; 10 s load 5 N; 4 x 90° 3 x 360° in opposite directions	number of failures: $< 1 \times 10^{-6}$ number of failures: $< 1 \times 10^{-6}$ no damage ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.20	29 (Eb)	bump	3 x 1500 bumps in three directions; 40 g	no damage ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.22	6 (Fc)	vibration	frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10 g; three directions; total 6 h (3 x 2 h)	no damage ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.19	14 (Na)	rapid change of temperature	30 min at LCT and 30 min at UCT; 5 cycles	no visual damage PR01: ΔR max.: $\pm (1 \% R + 0.05 \Omega)$ PR02: ΔR max.: $\pm (1 \% R + 0.05 \Omega)$ PR03: ΔR max.: $\pm (2 \% R + 0.05 \Omega)$
4.23 4.23.3 4.23.6	30 (Db) 30 (Db)	climatic sequence: damp heat (accelerated) 1 st cycle damp heat (accelerated) remaining cycles	6 days; 55 °C; 95 to 98 % RH	R_{ins} min.: $10^3 M\Omega$ ΔR max.: $\pm (3 \% R + 0.1 \Omega)$
4.24.2	3 (Ca)	damp heat (steady state) (IEC)	56 days; 40 °C; 90 to 95 % RH; loaded with 0.01 P_n (IEC steps: 4 to 100 V)	R_{ins} min.: 1000 M Ω ΔR max.: $\pm (3 \% R + 0.1 \Omega)$
4.25.1		endurance (at 70 °C)	1000 h; loaded with P_n or $V_{max.}$; 1.5 h ON and 0.5 h OFF	ΔR max.: $\pm (5 \% R + 0.1 \Omega)$
4.8.4.2		temperature coefficient	at 20/LCT/20 °C and 20/UCT/20 °C (TC x $10^{-6}/K$)	$\leq \pm 250$
OTHER TESTS IN ACCORDANCE WITH IEC 60115 CLAUSES AND IEC 60068 TEST METHOD				
4.17	20 (Tb)	solderability (after ageing)	8 h steam or 16 h 155 °C; leads immersed 6 mm for 2 ± 0.5 s in a solder bath at 235 ± 5 °C	good tinning (≥ 95 % covered); no damage
4.6.1.1		insulation resistance	maximum voltage (DC) after 1 min; metal block method	R_{ins} min.: $10^4 M\Omega$
see 2 nd amendment to IEC 60115-1, Jan. '87		pulse load		see Pulse Load Capabilities graphs

Metal Film Resistors, Special Purpose, Fusible, Flameproof



FEATURES

- Special filming and coating processes
- Fusible - Circuit protection in case of other component failure
- Flameproof - Meets EIA RS-325, will not flame when overloaded
- Tape and reel packaging is standard
- Lead (Pb)-free version is RoHS compliant



RoHS*
COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS					
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{70\text{ }^\circ\text{C}}$ W	RESISTANCE ⁽¹⁾ RANGE Ω	STANDARD TOLERANCE %	TEMPERATURE COEFFICIENT ppm/ $^\circ\text{C}$
CMF55..39	CMF-55-39	0.25	4R - 10K	± 1	100
CMF60..64	CMF-60-64	0.50	4R - 23K	± 1	100

Note:

⁽¹⁾ Contact factory for extended values

TECHNICAL SPECIFICATIONS			
PARAMETER	UNIT	CMF55..39	CMF60..64
Rated Dissipation at 70 $^\circ\text{C}$	W	0.25	0.50
Maximum Flame Test Voltage	V_{RMS}	350	500
Dielectric Strength	V_{AC}	450	750
Insulation Resistance	Ω	$\geq 10^{10}$	$\geq 10^{10}$
Operating Temperature Range	$^\circ\text{C}$	- 65/+ 165	- 65/+ 165
Weight (Max.)	g	0.20	0.50

GLOBAL PART NUMBER INFORMATION

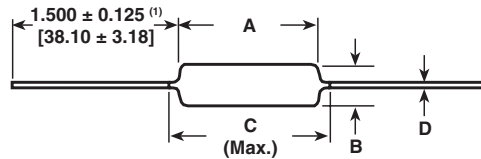
New Global Part Numbering: CMF55100R00FKRE39

C	M	F	5	5	1	0	0	R	0	0	F	K	R	E	3	9	
GLOBAL MODEL		RESISTANCE VALUE			TOLERANCE CODE		TEMPERATURE COEFFICIENT		PACKAGING				SPECIAL				
CMF55 CMF60		R = Decimal K = Thousand 4R0000 = 4.0 Ω 680R00 = 680 Ω 23K000 = 23 k Ω			F = $\pm 1\%$		K = 100 ppm		EK = Lead (Pb)-free, Bulk EA = Lead (Pb)-free, T/R (Full) EB = Lead (Pb)-free, T/R (1000 pieces) BF = Tin/Lead, Bulk RE = Tin/Lead, T/R (Full) R6 = Tin/Lead, T/R (1000 pieces)				39 = Fusible CMF55 64 = Fusible CMF60				

Historical Part Number example: CMF-55-391000F R36 (will continue to be accepted)

CMF-55-39	1000	F	R36
HISTORICAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING

* Pb containing terminations are not RoHS compliant, exemptions may apply.

DIMENSIONS in inches [millimeters]

Note:

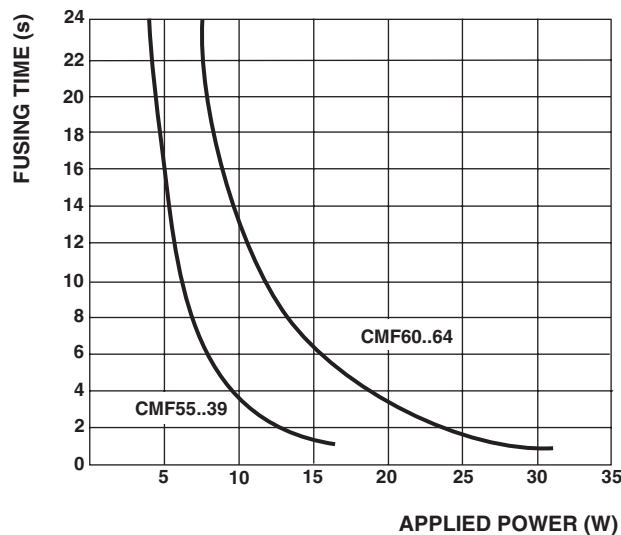
 (1) 1.08 ± 0.125 [27.43 ± 3.18] if tape and reel

GLOBAL MODEL	A	B	C (Max.)	D
CMF55..39	0.240 ± 0.020 [6.10 ± 0.51]	0.090 ± 0.008 [2.29 ± 0.21]	0.278 [7.06]	0.025 ± 0.002 [0.64 ± 0.05]
CMF60..64	0.370 ± 0.035 [9.40 ± 0.89]	0.145 ± 0.010 [3.68 ± 0.25]	0.425 [10.80]	0.032 ± 0.002 [0.81 ± 0.05]

MARKING

- DALE
- Model (C55-39 or C60-64)
- Value
- Tolerance, Temperature coefficient
- Date code

Fusing time graphs represent an average for the resistance value range. Low resistance parts require higher power to fuse than high resistance parts. It is recommended that values less than 200 Ω be evaluated for specific applications.


**FUSIBLE, FLAMEPROOF
(Typical Fusing Times)**

Fusible, Non-Flammable Resistors



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 coated with a grey, flame retardant lacquer which provides electrical, mechanical, and climatic protection. The encapsulation is resistant to all cleaning solvents in accordance with "MIL-STD-202E, method 215", and "IEC 60068-2-45".

FEATURES

- Overload protection without risk of fire
- Wide range of overload currents (refer Fusing Characteristics graphs)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- Audio
- Video

TECHNICAL SPECIFICATIONS		
DESCRIPTION	VALUE	
	NFR25	NFR25H
Resistance Range ⁽¹⁾	0.22 Ω to 15 kΩ	
Resistance Tolerance and Series	± 5 %; E24 series	
Maximum Dissipation at $T_{amb} = 70\text{ °C}$	0.33 W	0.5 W
Thermal Resistance R_{th}	240 K/W	150 K/W
Temperature Coefficient:		
0.22 Ω ≤ R ≤ 4.7 Ω	≤ ± 200 x 10 ⁻⁶ /K	≤ ± 200 x 10 ⁻⁶ /K
4.7 Ω < R ≤ 15 Ω	≤ ± 200 x 10 ⁻⁶ /K	≤ ± 100 x 10 ⁻⁶ /K
15 Ω < R ≤ 15 kΩ	≤ ± 100 x 10 ⁻⁶ /K	≤ ± 100 x 10 ⁻⁶ /K
Maximum Permissible Voltage (DC or RMS)	250 V	350 V
Basic Specifications	IEC 60115-1 and 60115-2	
Climatic Category (IEC 60068)	55/155/56	
Stability After:		
Load	ΔR max.: ± (1 % R + 0.05 Ω)	
Climatic Tests	ΔR max.: ± (1 % R + 0.05 Ω)	
Soldering	ΔR max.: ± (0.25 % R + 0.05 Ω)	

Notes:

- ⁽¹⁾ Ohmic values (other than resistance range) are available on request
 • R value is measured with probe distance of 24 ± 1 mm using 4-terminal method

12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 23
- The subsequent 7 digits indicate the resistor type and packaging
- The remaining 3 digits indicate the resistance values:
 - The first 2 digits indicate the resistance value
 - The last digit indicates the resistance decade

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
0.22 to 0.91 Ω	7
1 to 9.1 Ω	8
10 to 91 Ω	9
100 to 910 Ω	1
1 to 9.1 kΩ	2
10 to 15 kΩ	3

12NC Example

The 12NC for a NFR25 resistor with value 750 Ω, supplied on a bandolier of 1000 units in ammpack is: 2322 205 13751.



12NC - resistor type and packaging				
TYPE	ORDERING CODE 23..			
	BANDOLIER IN AMMOPACK			BANDOLIER ON REEL
	RADIAL TAPED	STRAIGHT LEADS		STRAIGHT LEADS
	4000 UNITS	1000 UNITS	5000 UNITS	5000 UNITS
NFR25	06 204 03...	22 205 13...	22 205 33...	22 205 23...
NFR25H	06 207 03...	22 207 13...	22 207 33...	22 207 23...

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER: NFR250002207JA100

N	F	R	2	5	0	0	0	0	2	2	0	7	J	A	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MODEL/SIZE NFR2500 NFR25H0	SPECIAL CHARACTER 0 = Neutral Z = Value overflow (Special)	TCR/MATERIAL 0 = Standard	VALUE 3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 8 = *10 ⁻² 9 = *10 ⁻¹ 0 = *10 ⁰ 1 = *10 ¹ 2 = *10 ²	TOLERANCE J = ± 5 %	PACKAGING (1) N4 A5 A1 R5	SPECIAL The 2 digits are used for all special parts. 00 = Standard
----------------------------------	--	------------------------------	---	------------------------	---------------------------------------	--

PRODUCT DESCRIPTION: NFR25 5 % A1 R22

NFR25	5 %	A1	R22
MODEL/SIZE NFR25 NFR25H	TOLERANCE ± 5 %	PACKAGING (1) N4 A5 A1 R5	RESISTANCE VALUE 1K0 = 1 kΩ 4R7 = 4.7 Ω

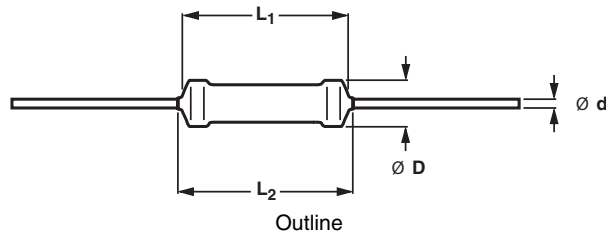
Notes:

(1) Please refer to table PACKAGING for details.

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products.

PACKAGING			
CODE	PIECES	DESCRIPTION	MODEL/SIZE
N4	4000	Bandolier in ammpack radial taped	NFR25, NFR25H
A5	5000	Bandolier in ammpack straight leads	
A1	1000	Bandolier in ammpack straight leads	
R5	5000	Bandolier on reel straight leads	

DIMENSIONS



DIMENSIONS - resistor types and relevant physical dimensions				
TYPE	$\varnothing D_{max.}$	L_1 max.	L_2 max.	$\varnothing d$
NFR25	2.5	6.5	7.5	0.58 ± 0.05
NFR25H				

MASS PER 100 UNITS	
TYPE	MASS (g)
NFR25	20.1
NFR25H	20.1

OUTLINES

The length of the body (L_1) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation ("IEC publication 60294").

MARKING

The nominal resistance and tolerance are marked on the resistor using four coloured bands in accordance with IEC publication 60062 "Color codes for fixed resistors".

For ease of recognition a fifth ring is added, which is violet for type NFR25 and white for type NFR25H.

FUNCTIONAL PERFORMANCE PRODUCT CHARACTERIZATION

Standard values of nominal resistance are taken from the E24 series for resistors with a tolerance of $\pm 5\%$.

The values of the E24 series are in accordance with "IEC publication 60063".

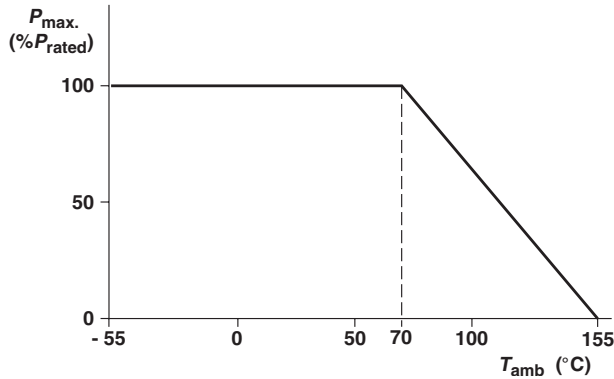
LIMITING VALUES		
TYPE	LIMITING VOLTAGE ⁽¹⁾ (V)	LIMITING POWER (W)
NFR25	250	0.33
NFR25H	350	0.5

Note:

⁽¹⁾ The maximum voltage that may be continuously applied to the resistor element, see "IEC publication 60115-1".

The maximum permissible hot-spot temperature is 155 °C.

The power that the resistor can dissipate depends on the operating temperature.

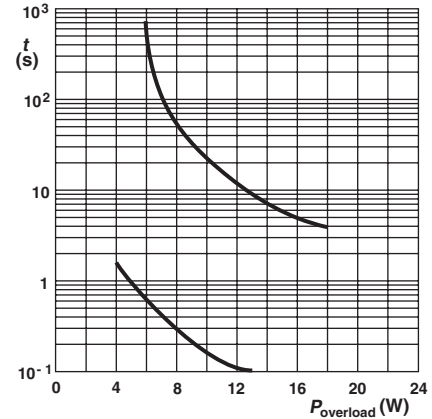


Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb})

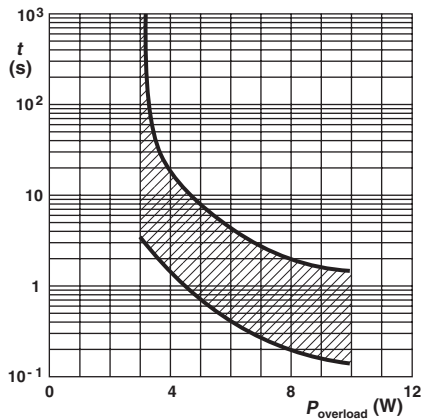
Derating

The resistors will fuse without the risk of fire and within an indicated range of overload. Fusing means that the resistive value of the resistor increases at least 100 times.

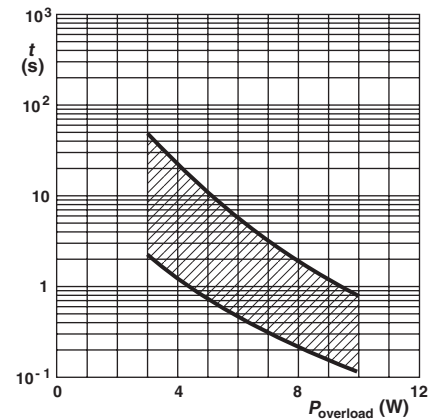
The fusing characteristic is measured under constant voltage.



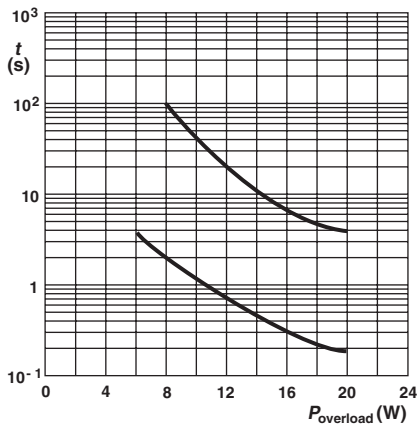
NFR25 This graph is based on measured data which may deviate according to the application. Fusing Characteristics: $\leq 1 \Omega$



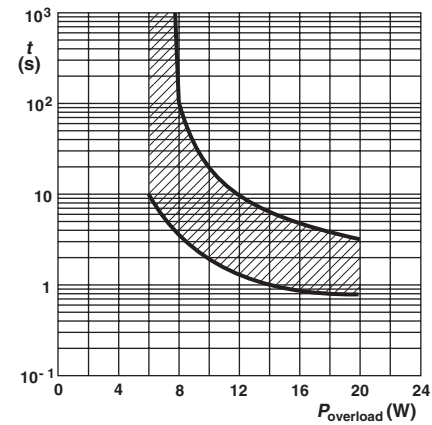
NFR25 This graph is based on measured data which may deviate according to the application. Fusing Characteristics: $1 \Omega \leq R \leq 15 \Omega$



NFR25 This graph is based on measured data which may deviate according to the application. Fusing Characteristics: $15 \Omega \leq R \leq 15 \text{ k}\Omega$

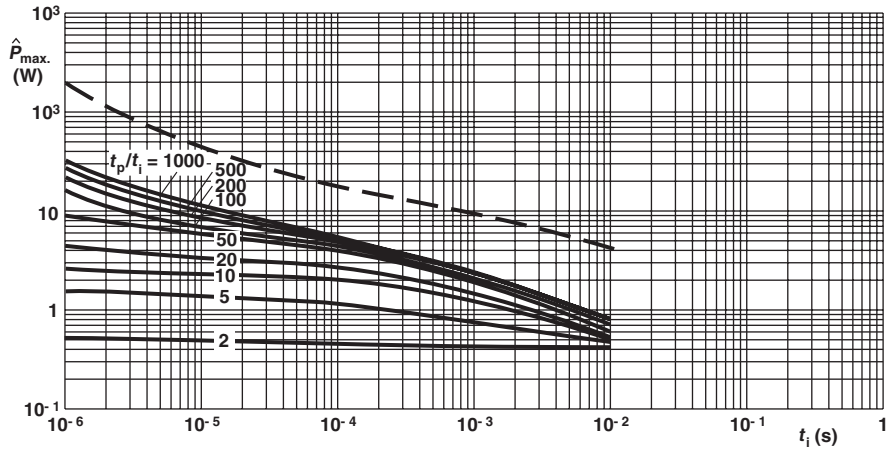


NFR25H This graph is based on measured data which may deviate according to the application. Fusing Characteristics: $\leq 1 \Omega$

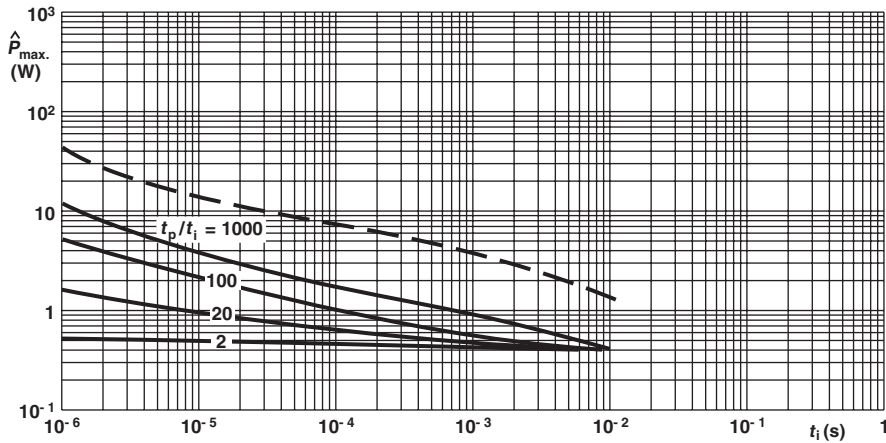


NFR25H This graph is based on measured data which may deviate according to the application. Fusing Characteristic: $1 \Omega \leq R \leq 15 \text{ k}\Omega$

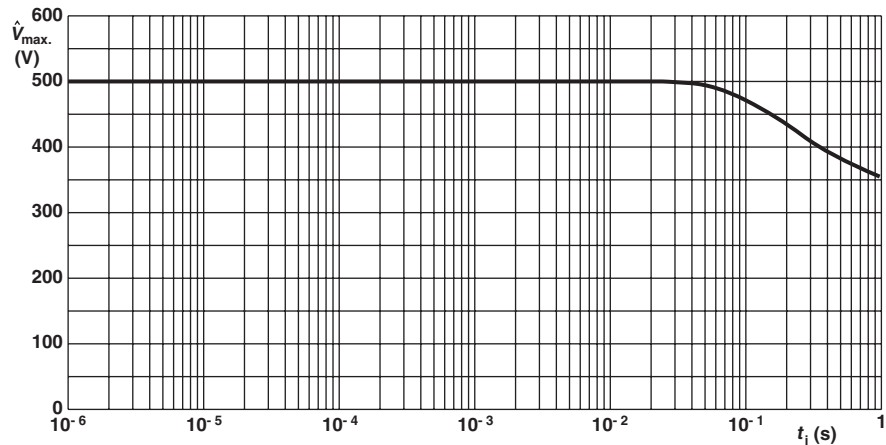
Fusing Characteristics



NFR25 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i), $0.22 \Omega \leq R < 15 \Omega$

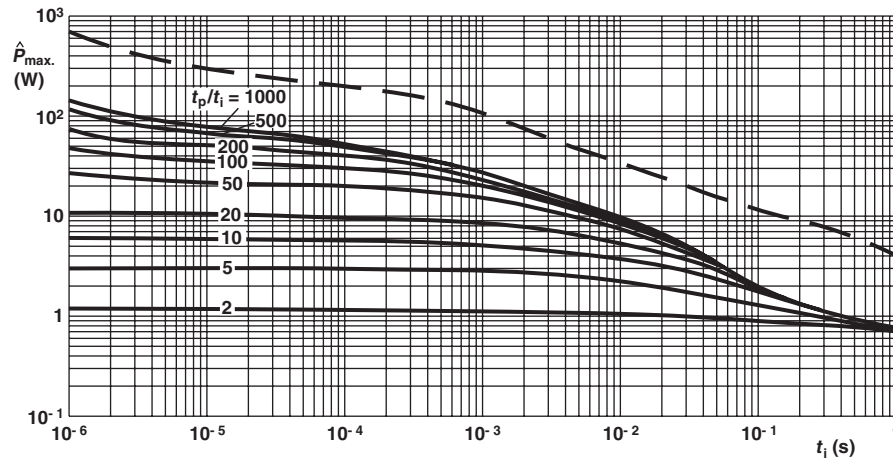


NFR25 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i), $15 \Omega < R \leq 15 \text{ k}\Omega$

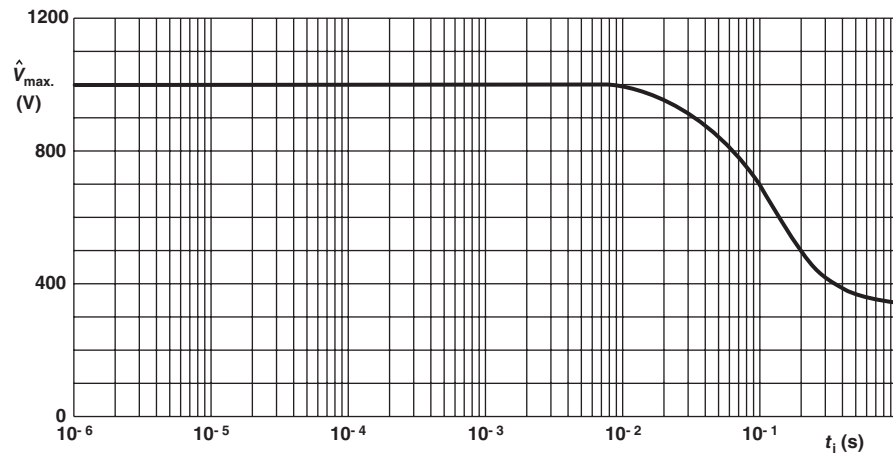


NFR25 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max.}$) as a function of pulse duration (t_i)

Pulse Loading Capabilities

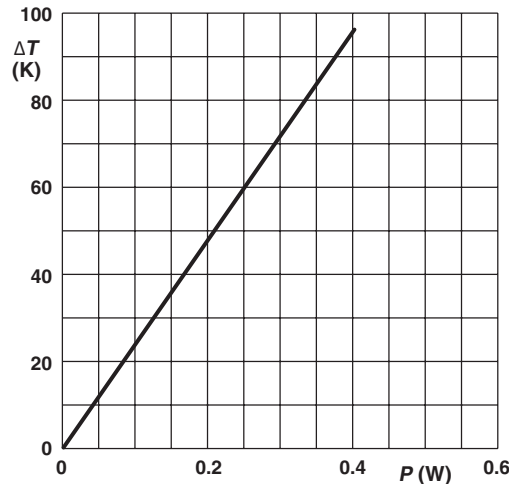


NFR25H Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i)



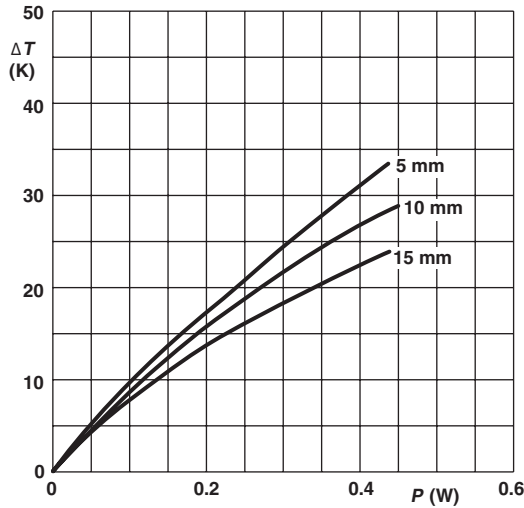
NFR25H Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max.}$) as a function of pulse duration (t_i)

Pulse Loading Capabilities



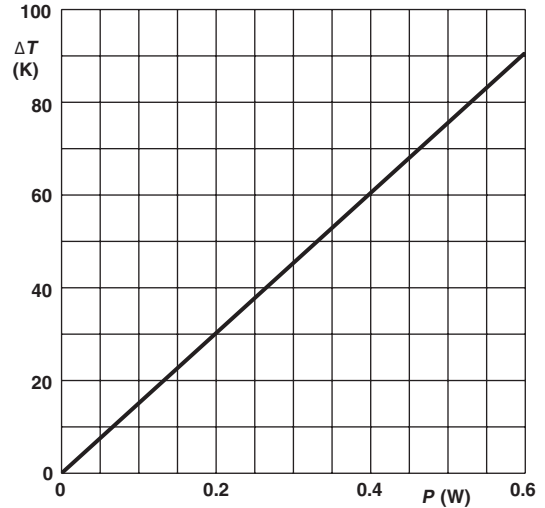
NFR25 Hot-spot temperature rise (ΔT) as a function of dissipated power

Application Information

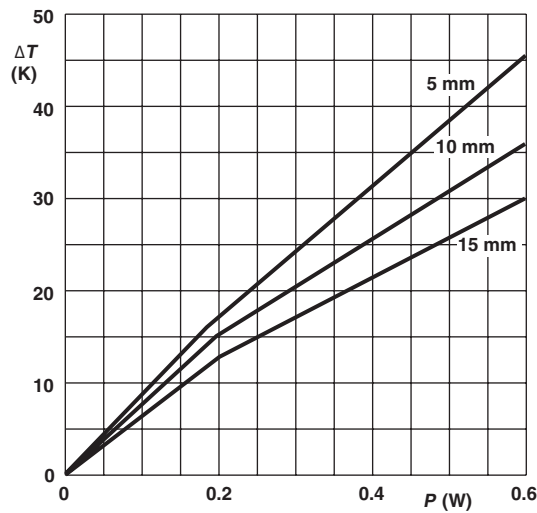


Minimum distance from resistor body to PCB = 1 mm

NFR25 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting



NFR25H Hot-spot temperature rise (ΔT) as a function of dissipated power.



Minimum distance from resistor body to PCB = 1 mm

NFR25H Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting

Application Information

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-1", category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 60068-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to "IEC 60068-1", subclause 5.3.

In the Test Procedures and Requirements table the tests and requirements are listed with reference to the relevant clauses of "IEC publications 60115-1 and 60068-2"; a short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying. For inflammability requirements reference is made to "IEC 60115-1" and to "EN 140000, appendix D".

All soldering tests are performed with mildly activated flux.



TEST PROCEDURES AND REQUIREMENTS					
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				NFR25	NFR25H
TESTS IN ACCORDANCE WITH THE SCHEDULE OF IEC PUBLICATION 60115-8					
4.4.1		visual examination		no holes; clean surface; no damage	
4.4.2		dimensions (outline)	gauge (mm)	see Dimensions Table	
4.5		resistance (refer note on first page for measuring distance)	applied voltage (+ 0/- 10 %): $R < 10 \Omega$: 0.1 V $10 \Omega \leq R < 100 \Omega$: 0.3 V $100 \Omega \leq R < 1 \text{ k}\Omega$: 1 V $1 \text{ k}\Omega \leq R < 10 \text{ k}\Omega$: 3 V $10 \text{ k}\Omega \leq R \leq 15 \text{ k}\Omega$: 10 V	$R - R_{nom}$: max. $\pm 5 \%$	
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 3 mm from body	ΔR max.: $\pm (0.25 \% R + 0.05 \Omega)$	
4.29	45 (Xa)	component solvent resistance	isopropyl alcohol or H ₂ O followed by brushing in accordance with "MIL 202 F"	no visual damage	
4.17	20 (Ta)	solderability	2 s; 235 °C	good tinning; no damage	
4.7		voltage proof on insulation	$U_{RMS} = 500 V_{RMS}$ during 1 min; metal block method	no breakdown or flashover	
4.16	21 (U)	robustness of terminations:			
4.16.2	21 (Ua1)	tensile all samples	load 10 N; 10 s	number of failures $< 10 \times 10^{-6}$	
4.16.3	21 (Ub)	bending half number of samples	load 5 N; 4 x 90°	number of failures $< 10 \times 10^{-6}$	
4.16.4	21 (Uc)	torsion other half of samples	3 x 360° in opposite directions	no damage ΔR max.: $\pm (0.25 \% R + 0.05 \Omega)$	
4.20	29 (Eb)	bump	3 x 1500 bumps in 3 directions; 40 g	no damage ΔR max.: $\pm (0.25 \% R + 0.05 \Omega)$	
4.22	6 (Fc)	vibration	frequency 10 Hz to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 h (3 x 2 h)	no damage ΔR max.: $\pm (0.25 \% R + 0.05 \Omega)$	
4.19	14 (Na)	rapid change of temperature	30 min at LCT and 30 min at UCT; 5 cycles	no visual damage ΔR max.: $\pm (0.25 \% + 0.05 \Omega)$	
4.23		climatic sequence:			
4.23.3	30 (Db)	damp heat (accelerated) 1 st cycle			
4.23.6	30 (Db)	damp heat (accelerated) remaining cycles	6 days; 55 °C; 95 % to 98 % RH	R_{ins} min.: 10 ³ MW ΔR max.: $\pm (1 \% R + 0.05 \Omega)$	
4.24.2	3 (Ca)	damp heat (steady state) (IEC)	56 days; 40 °C; 90 % to 95 % RH; loaded with 0.01 Pn (IEC steps: 4 to 100 V)	R_{ins} max.: 1000 MΩ ΔR max.: $\pm (1 \% R + 0.05 \Omega)$	
4.25.1		endurance (at 70 °C)	1000 h; loaded with Pn or V_{max} ; 1.5 h ON and 0.5 h OFF	ΔR max.: $\pm (1 \% R + 0.05 \Omega)$	
4.25.3		endurance at upper category temperature	1000 h; no load	ΔR max.: $\pm (1 \% R + 0.05 \Omega)$	
4.8.4.2		temperature coefficient	at 20/LCT/20 °C and 20/UCT/20 °C (TCR x 10 ⁻⁶ /K): $0.22 \Omega \leq R \leq 4.7 \Omega$ $4.7 \Omega < R \leq 15 \Omega$ $15 \Omega < R \leq 15 \text{ k}\Omega$	$\leq \pm 200 \times 10^{-6}/K$ $\leq \pm 200 \times 10^{-6}/K$ $\leq \pm 100 \times 10^{-6}/K$	$\leq \pm 200 \times 10^{-6}/K$ $\leq \pm 100 \times 10^{-6}/K$ $\leq \pm 100 \times 10^{-6}/K$
4.12		noise	"IEC publication 60195"	$< 0.1 \mu V/V$	
4.26		accidental overload	cheese-cloth	nonflammable	
OTHER TESTS IN ACCORDANCE WITH IEC 60115 CLAUSES AND IEC 60068 TEST METHOD					
4.17	20 (Ta)	solderability (after ageing)	8 h steam or 16 h 155 °C; leads immersed 6 mm for 2 ± 0.5 s in a solder bath at 235 ± 5 °C	good tinning ($\geq 95 \%$ covered); no damage	
4.6.1.1		insulation resistance	maximum voltage U_{max} . DC = 500 V after 1 min; metal block method	R_{ins} min.: 10 ⁴ MΩ	
see 2 nd amendment to "IEC 60115-1", Jan.'87		pulse load		see the Pulse Loading Capabilities graphs	

Metal Film Resistors, Fusible Type



FEATURES

- Fusible resistor for constant current designed for overload protection
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- High positive temperature coefficient (refer to graph)
- Flame retardant coating
- Definded switch-off behaviour



STANDARD ELECTRICAL SPECIFICATIONS						
MODEL	DIN SIZE	POWER RATING $P_{70^{\circ}\text{C}}$ W	TEMPERATURE COEFFICIENT ppm/K	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
NKS2	0207	0.4	see diagram	± 5 $\pm 10, \pm 20$	1R0 - 20R R10 - 20R	12 - 24 12
NKS4	0414	0.7	see diagram	± 5 $\pm 10, \pm 20$	1R0 - 20R R10 - 20R	12 - 24 12

Notes:

- Further values on request
- Rated voltage $\sqrt{P \times R}$
- Coating: red-brown
- Marking: additional 5th band, black

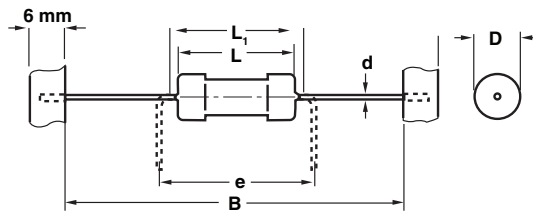
PART NUMBER AND PRODUCT DESCRIPTION						
PART NUMBER: NKS2207B01009K2500						
N	K	S	2	2	0	7
B	0	1	0	0	9	K
2	5	0	0			
MODEL/SIZE NKS2207 NKS4414	SPECIAL CHARACTER B = Fusible	TCR 0 = Neutral see diagram	VALUE 3 digit value 1 digit multiplier MULTIPLIER 7 = $\times 10^{-3}$ 8 = $\times 10^{-2}$ 9 = $\times 10^{-1}$ 0 = $\times 10^0$	TOLERANCE J = $\pm 5\%$ K = $\pm 10\%$ M = $\pm 20\%$	PACKAGING ⁽¹⁾ 22 = A2 25 = A5 41 = A1 D5 = R5 DE = RE GP = RP	SPECIAL Up to 2 digits 00 = Standard
PRODUCT DESCRIPTION: NKS2 10R 10% A5						
NKS2	10R	10%	A5			
MODEL	RESISTANCE VALUE	TOLERANCE	PACKAGING ⁽¹⁾			
NKS2 NKS4	1R0 = 1 Ω 10R = 10 Ω	$\pm 5\%$ $\pm 10\%$ $\pm 20\%$	R5 RE RP A5 A2 A1			

Notes:

⁽¹⁾ Please refer to table PACKAGING, page 134.

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products.

DIMENSIONS

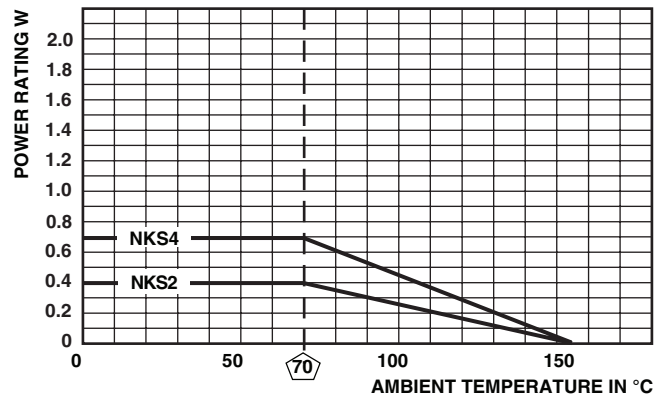


MODEL	DIMENSIONS [in millimeters]					
	D	L	L ₁ max.	B	d	e
NKS2	2.5 - 0.5	6.0 - 0.5	7.0	53 ± 1 ⁽¹⁾	0.6	7.5
NKS4	4.1 - 0.5	12.0 - 1.5	14.0	73 ± 1 ⁽¹⁾	0.8	15

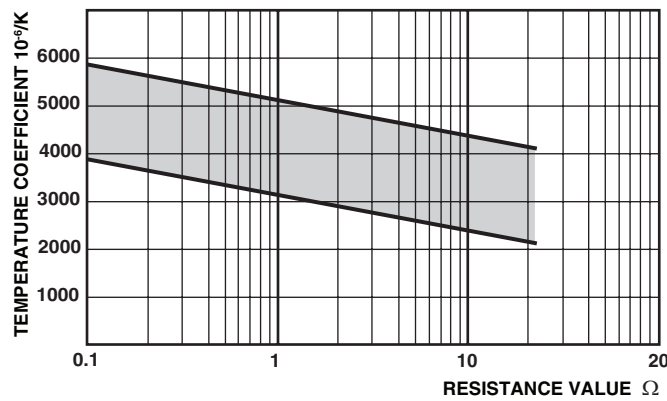
Note:

- ⁽¹⁾ Also available in 26 mm tape spacing
- D and L measured in acc. with IEC60294
- D and L measured in acc. with IEC60294
- d according to IEC60301

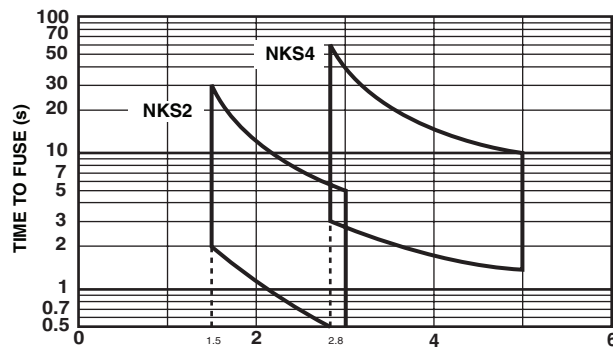
TECHNICAL SPECIFICATIONS			
PARAMETER	UNIT	NKS2	NKS4
Rated Dissipation at 70 °C	W	0.4	0.7
Minimum Overload to Fuse	W	1.5	2.8
Time to Fuse (max)	s	30	60
Voltage Coefficient	1/V	< 10 ⁻⁷	
Thermal Resistance	K/W	≤ 220	≤ 130
Thermal Time Constant τ	s	8	20
Category Temperature Range	°C	- 55 to + 155	
Failure Rate	10 ⁻⁹ /h	< 30	
Weight	g	0.2	0.7



DERATING



TEMPERATURE COEFFICIENT



OPENING POWER IN W CALCULATED WITH RATED RESISTANCE

FUSING PERFORMANCE



PACKAGING						
MODEL	REEL			BOX		
	PIECES/REEL	CODE	MIN. ORDER QTY PACKAGING UNITS	PIECES/BOX	CODE	MIN. ORDER QTY PACKAGING UNITS
NKS2	5000	R5	1	2000	A2	2
				5000	A5	1
NKS4	2500	RE	1	1000	A1	1

Metal Film Resistors, Fusible Type



FEATURES

- Fusible resistor for constant current designed for overload protection
- High positive temperature coefficient (+ 4500/± 500 ppm/K)
- Flame retardent coating
- Defined switch-off behavior
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



STANDARD ELECTRICAL SPECIFICATIONS

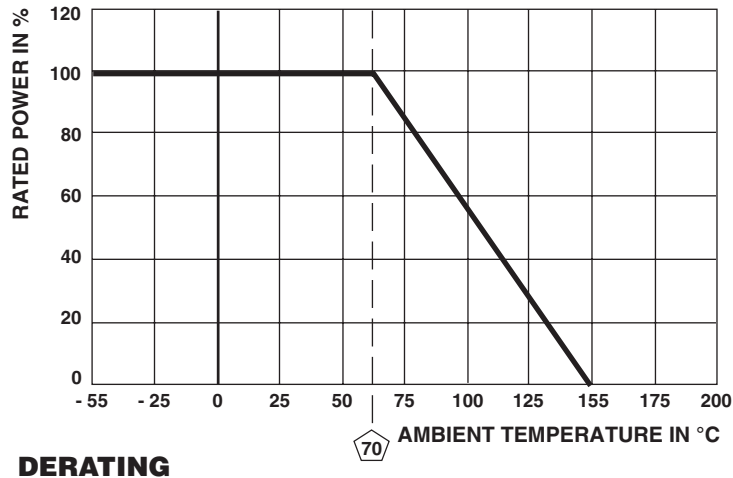
MODEL	POWER RATING $P_{70\text{ }^{\circ}\text{C}}$ W	TEMPERATURE COEFFICIENT ppm/K	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
NMA0207SI	0.35	+ 4500/± 500	5, 10, 20 10, 20	1R0 - 47R R10 - R91	12 - 24 12

Notes:

- Further values on request
- Marking: additional 5th band, black
- Coating: beige

TECHNICAL SPECIFICATIONS

PARAMETER	UNIT	NMA0207SI
Rated Dissipation at 70 °C	W	0.35
Minimum Overload to Fuse	W	1.5
Time to Fuse (Max.)	s	30
Thermal Resistance (Max.)	K/W	≤ 220
Max. Applicable Voltage after Fusing	V	85
Category Temperature Range	°C	- 55 to + 155
Failure Rate	10 ⁻⁹ /h	< 30
Weight	g	0.22

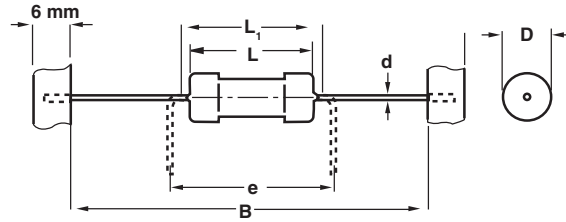


PART NUMBER AND PRODUCT DESCRIPTION																	
PART NUMBER: NMA0207B01508J2200																	
N	M	A	0	2	0	7	B	0	1	5	0	8	J	2	2	0	0
MODEL/SIZE		SPECIAL CHARACTER		TCR/MATERIAL		VALUE			TOLERANCE			PACKAGING (1)		SPECIAL			
NMA0207		B = SI Fusible		0 = Standard		3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 8 = *10 ⁻² 9 = *10 ⁻¹			J = ± 5 % K = ± 10 % M = ± 20 %			22 = A2 25 = A5 D5 = R5		Up to 2 digits 00 = Standard			
PRODUCT DESCRIPTION: NMA0207 SI 1R5 5% A2																	
NMA0207		SI		1R5		5 %			A2								
MODEL/SIZE		SPECIAL CHARACTER		RESISTANCE VALUE			TOLERANCE			PACKAGING (1)							
NMA0207		FUSIBLE		1R5 = 1.5 Ω 47R = 47 Ω			± 5 % ± 10 % ± 20 %			A2 A5 R5							

Note:

(1) Please refer to table PACKAGING, see next page

DIMENSIONS

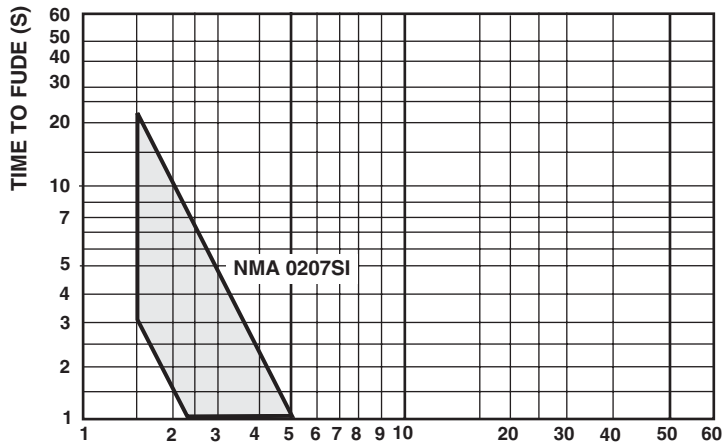


MODEL	DIMENSIONS [in millimeters]					
	D	L	L ₁ max.	B	d	e
NMA0207SI	2.3 - 0.3	6.1 - 0.5	8.1	53 ± 1 ⁽¹⁾	0.6	7.5

Note:

⁽¹⁾ Also available in 26 mm taping

- Taping in acc. with IEC60286-1
- D and L measured in acc. with IEC60294
- d according to IEC60301



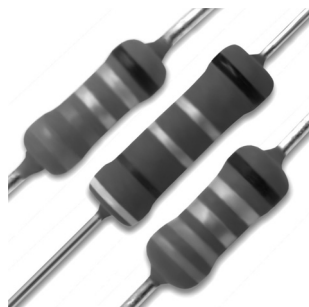
FUSING PERFORMANCE



PERFORMANCE		
TEST	CONDITIONS OF TEST	REQUIREMENTS
Endurance at 70 °C IEC 60115-1 4.25.1	1000 h at 70 °C 1.5 h ON, 0.5 h OFF	$\leq \pm 1 \%$
Endurance at UCT IEC 60115-1 4.25.3	1000 h at 155 °C without load	$\leq \pm 1 \%$
Thermal Shock IEC 60115-1 4.19, IEC 60068-2-14	Rapid change between upper and lower category temperature	$\leq \pm 0.25 \%$
Damp Heat Steady State IEC 60115-1 4.24, IEC 60068-2-3	56 days at 40 °C and 93 % relative humidity	$\leq \pm 1.5 \%$
Resistance to Soldering Heat IEC 60115-1 4.18, IEC 60068-2-20	10 s at 260 °C solder bath temperature	$\leq \pm 0.25 \%$

PACKAGING						
MODEL	REEL			BOX		
	PIECES/REEL	CODE	MIN. ORDER QTY PACKAGING UNITS	PIECES/BOX	CODE	MIN. ORDER QTY PACKAGING UNITS
NMA0207SI	5000	R5	1	5000 2000	A5 A2	1 2

Fusible Power Metal Film Leaded Resistors



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 electrolytic copper wires are welded to the end-caps. The resistors are coated with a red non-flammable lacquer, which provides electrical, mechanical, and climatic protection.

The encapsulation is resistant to all cleaning solvents in accordance with "MIL-STD 202E, method 215" and "IEC 60068-2-45".

FEATURES

- Metal film technology
- High power (up to 3 W) in small package
- Small standard sizes (0207/0414/0617)
- High stability, reliability and uniformity characteristics
- Defined interruption behaviour (fusing time)
- Various forming styles
- Non-flammable
- Compatible with lead (Pb)-free and lead containing soldering processes
- Lead (Pb)-free and RoHS compliant



APPLICATIONS

- Audio
- Video

TECHNICAL SPECIFICATIONS			
DESCRIPTION	NFR01	NFR02	NFR03
Resistance Range ⁽¹⁾	0.47 Ω to 1 kΩ		
Resistance Tolerance	± 5 %; E24 series		
Temperature Coefficient	± 200 ppm/K		
Climatic Category (LCT/UCT/Days)	55/155/56		
Rated Dissipation P_{70}	1 W	2 W	3 W
Maximum Permissible Voltage: DC or RMS	350 V	500 V	
Fusing Power	0.47 Ω to 10 Ω; ≥ 20 x Pn		
	10.1 Ω to 1 kΩ; ≥ 16 x Pn		
Fusing Time	≤ 60 s		
Maximum Resistance Change at P_{70} for Resistance Range, ΔR max., After:	Load	± (5 % R + 0.1 Ω)	
	Climatic Tests	± (3 % R + 0.1 Ω)	
	Resistance to Soldering Heat	± (1 % R + 0.05 Ω)	

Note:

⁽¹⁾ Resistance values below 0.47 Ω with ± 10 % tolerance are available on request



12NC INFORMATION FOR HISTORICAL CODING REFERENCE ONLY

- The resistors have a 12 digit ordering code starting with 2306
- The next 5 digits indicate the resistor type and packaging
- The last 3 digits indicate the resistance value:
 - The first 2 digits indicate the actual resistance value
 - The last digit indicates the resistance decade in accordance with table

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
0.47 Ω to 0.91 Ω	7
1 Ω to 9.1 Ω	8
10 Ω to 91 Ω	9
100 Ω to 910 Ω	1
1 kΩ	2

12NC Example

NFR01, 1 Ω, ± 5 %, ammpack 1000 pieces is
2306 208 13108

12NC - resistor type and packaging						
DESCRIPTION			ORDERING CODE 2306			
			BANDOLIER IN AMMPACK			BANDOLIER ON REEL
TYPE	TAPE WIDTH	TOL.	500 UNITS	1000 UNITS	5000 UNITS	5000 UNITS
NFR01	52.5	± 5 %	-	208 13...	208 53...	208 23...
NFR02	52.5	± 5 %	-	209 13...	-	209 23...
NFR03	63.0	± 5 %	210 13...	-	-	-

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER ⁽¹⁾: NFR0100001008JA100

N	F	R	0	1	0	0	0	0	1	0	0	8	J	A	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MODEL/SIZE NFR0100 NFR0200 NFR0300	SPECIAL CHARACTER 0 = Neutral	TCR/MATERIAL 0 = Standard	VALUE 3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 8 = *10 ⁻² 9 = *10 ⁻¹ 0 = *10 ⁰ 1 = *10 ¹ 2 = *10 ² 3 = *10 ³ 4 = *10 ⁴	TOLERANCE J = ± 5 %	PACKAGING ⁽²⁾ A1 A5 R5 AC	SPECIAL Up to 2 digits 00 = Standard
---	----------------------------------	------------------------------	---	------------------------	--	--

PRODUCT DESCRIPTION: NFR01 5 % A1 1R0

NFR01 MODEL NFR01 NFR02 NFR03	5 % TOLERANCE ± 5 %	A1 PACKAGING ⁽²⁾ A1 A5 R5 AC	1R0 RESISTANCE VALUE 1R0 = 1 Ω 470R = 470 Ω
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Notes:

- (1) The PART NUMBER is shown to facilitate the introduction of the unified part numbering system
- (2) Please refer to table PACKAGING, see next page

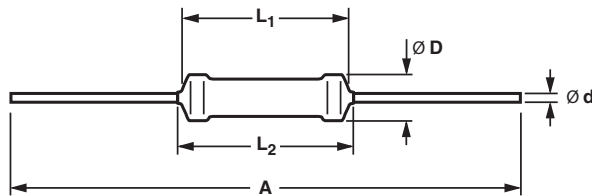
NFR01, NFR02, NFR03



Vishay BCcomponents Fusible Power Metal Film Leaded Resistors

PACKAGING				
MODEL	REEL		BOX	
	PIECES	CODE	PIECES	CODE
NFR01	5000	R5	1000 5000	A1 A5
NFR02	5000	R5	1000	A1
NFR03	-	-	500	AC

DIMENSIONS

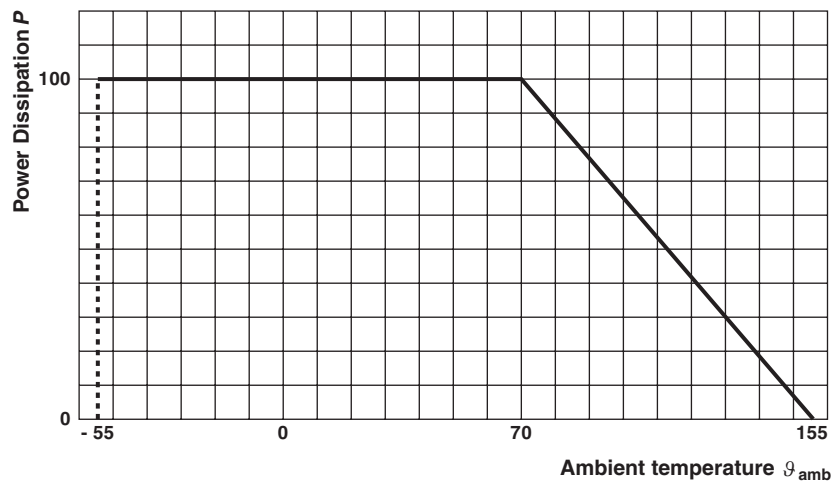


DIMENSIONS - resistor types, mass and relevant physical dimensions						
TYPE	L_1 max. (mm)	L_2 max. (mm)	D_{max} (mm)	$\varnothing d$ (mm)	A (mm)	MASS (g)/ 100 pieces
NFR01	6.5	8.5	2.5	0.58 ± 0.05	52.5 ± 1.5	22
NFR02	10	12	4	0.80 ± 0.03	52.5 ± 1.5	50
NFR03	16.7	19.5	5.3	0.80 ± 0.03	63.0 ± 1.5	120

MARKING

The nominal resistance and tolerance are marked on the resistor using four colored bands in accordance with IEC 60062 "Color code for fixed resistors". There is a fifth black band in order to indicate the type of resistor. Standard values of nominal resistance are taken from the E24 series for resistors with a tolerance of $\pm 5\%$.

FUNCTIONAL PERFORMANCE



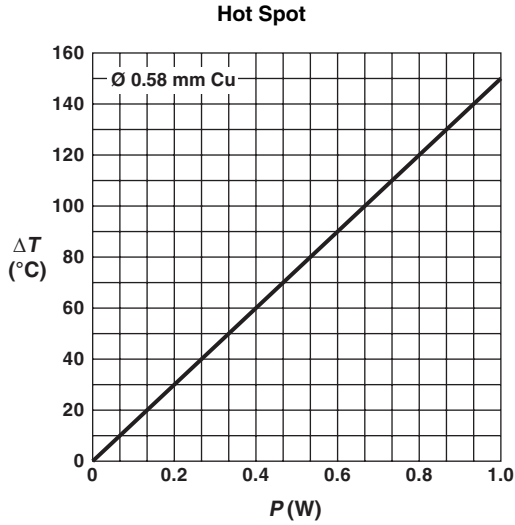
Derating - Standard Operation

Maximum dissipation (P_{max}) in percentage of rated power as a function of ambient temperature (T_{amb})

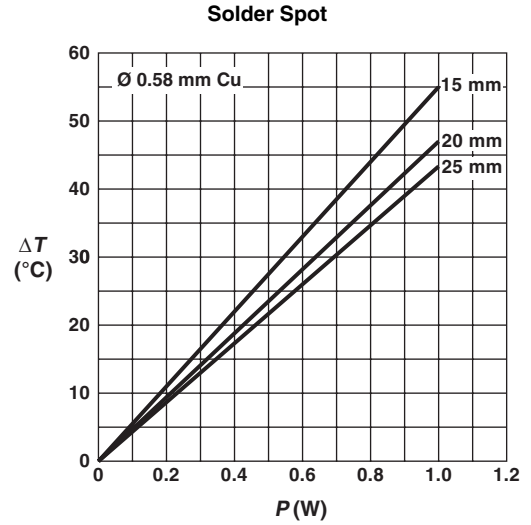


APPLICATION INFORMATION

NFR01

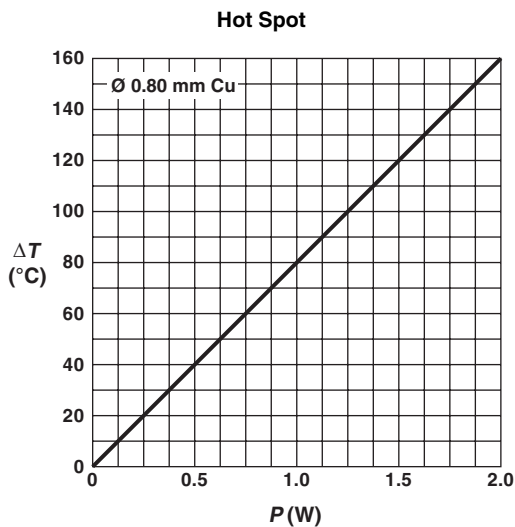


Hot spot temperature rise (ΔT) as a function of dissipated power

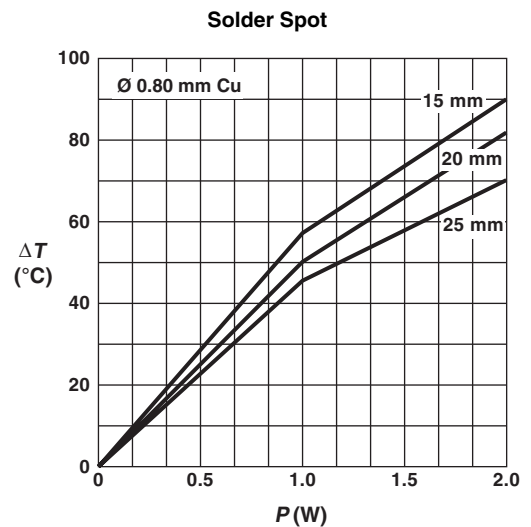


Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various leads lengths after mounting

NFR02

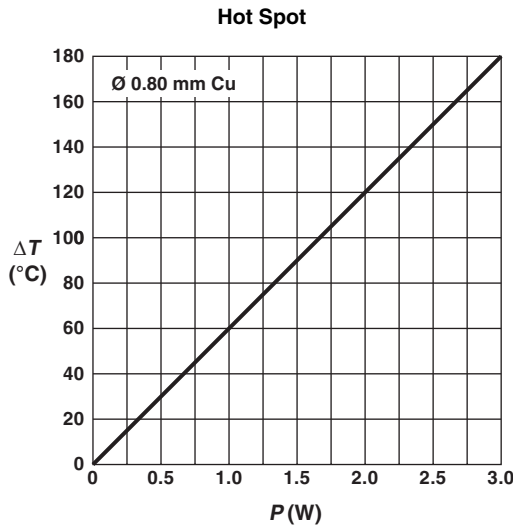


Hot spot temperature rise (ΔT) as a function of dissipated power

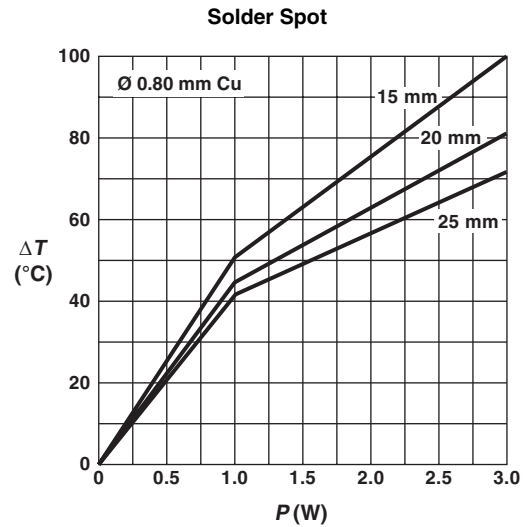


Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various leads lengths after mounting

NFR03



Hot spot temperature rise (ΔT) as a function of dissipated power



Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various leads lengths after mounting

FUSING CHARACTERISTIC

The resistors will fuse without the risk of fire and within an indicated range of overload. Fusing means that the resistive value of the resistor increases at least 100 times.

RESISTANCE RANGE	POWER OVERLOAD	FUSING TIME
0.47 Ω - 10 Ω	≥ 20 x maximum dissipation at 70 °C (P_n)	≤ 60 s
10.1 Ω - 1 k Ω	≥ 16 x maximum dissipation at 70 °C (P_n)	

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of IEC 60115-1, category 55/155/56 (rated temperature range - 55 to + 155 °C; damp heat, long term, 56 days) and along the lines of IEC 60068-2; "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmosphere conditions according to IEC 60068-1 subclause 5.3, unless otherwise specified. In some instances deviations from IEC applications were necessary for our specified method.

PERFORMANCE						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
				NFR01	NFR02	NFR03
4.8	-	Temperature coefficient	Between - 55 °C and + 155 °C	± 200 ppm/K		
4.25.1	-	Endurance at 70 °C	1000 h; loaded with P_n or V_{max} ; 1.5 h ON; 0.5 h OFF	$\pm (5\% R + 0.1 \Omega)$		
4.26	-	Accidental overload	Overload of 5, 10, 16, 25, 40, 63 and 100 times the rated power, but the applied voltage shall not exceed four times the limiting voltage.	Non-flammable		



PERFORMANCE						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
				NFR01	NFR02	NFR03
4.24	3 (Ca)	Damp heat, steady state	56 days; 40 °C; 90 to 95 % RH loaded with 0.01 Pn	R_{ins} min. $10^3 M\Omega$ $\pm (3\% R + 0.1 \Omega)$		
4.16 4.16.2 4.16.3 4.16.4	21 (U) 21 (Ua1) 21 (Ub) 21 (Uc)	Robustness of terminations: Tensile all samples Bending half number of samples Torsion other half of samples	Load 10 N; 10 s Load 5 N; 4 x 90° 3 x 360° in opposite direction	No damage $\pm (0.5\% R + 0.05 \Omega)$		
4.19	14 (Na)	Rapid change of temperature	30 min at LCT; 30 min at UCT; LCT = - 55 °C; UCT = 155 °C; 5 cycles	$\pm (1\% R + 0.05 \Omega)$	$\pm (1\% R + 0.05 \Omega)$	$\pm (2\% R + 0.05 \Omega)$
4.23 4.23.2 4.23.3 4.23.4 4.23.6	2 (Ba) 30 (Db) 1 (Aa) 30 (Db)	Climatic sequence Dry heat Damp heat (accelerated) Cold Damp heat, (accelerated) remaining cycles	16 h, 155 °C 24 h; 25 °C to 55 °C 90 % to 100 % RH; 1 cycle 2 h, - 55 °C 5 days; 25 °C to 55 °C 90 to 100 % RH	R_{ins} min. $10^3 M\Omega$ $\pm (3\% R + 0.1 \Omega)$		
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 500 Hz; displacement 1.5 mm or acceleration 10 g; 6 h (3 x 2 h)	No visual damage $\pm (0.5\% R + 0.05 \Omega)$		
4.17	20 (Ta)	Solderability (after ageing)	16 h at 155 °C; immersed in flux 600, leads immersed 2 mm in solder bath at (235 ± 5) °C for (2 ± 0.5) s	Good tinning (≥ 95 % covered); no visible damage		
4.18	20 (Tb)	Resistance to soldering heat	Solder bath method; (350 ± 10) °C; 6 mm from body; for 3 s	$\pm (1\% R + 0.05 \Omega)$		
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol; MIL STD 202E	No visible damage		
4.7	-	Voltage proof on insulation	500 V _{RMS} during 1 min, V-block method	No flashover or breakdown		
4.6.1.1	-	Insulation resistance	500 V _{DC} during 1 min, V-block method	R_{ins} min. $10^4 M\Omega$		

High Ohmic (up to 33 MΩ), High Voltage (up to 10 kV) Metal Film Leaded Resistors



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 electrolytic copper wires are welded to the end-caps. The resistors are coated with a blue, non-flammable lacquer, which provides electrical, mechanical, and climatic protection.

The encapsulation is resistant to all cleaning solvents in accordance with "MIL-STD 202E, method 215" and "IEC 60068-2-45".

FEATURES

- Metal film technology
- High pulse loading (up to 10 kV) capability
- Small size (0207/0411/0617)
- HVR37, HVR68 meets safety requirements of "IEC 60065", "EN 60065", "VDE 0860", "BS 60065"
- Compatible with lead (Pb)-free and lead containing soldering processes
- Lead (Pb)-free and RoHS compliant



APPLICATIONS

- Power supplies
- Electronic ballast
- White goods
- Television

TECHNICAL SPECIFICATIONS						
DESCRIPTION	HVR25		HVR37		HVR68	
Resistance Range	100 kΩ to 22 MΩ	100 kΩ to 10 MΩ	100 kΩ to 33 MΩ	100 kΩ to 10 MΩ	100 kΩ to 10 MΩ	
Resistance Tolerance	± 5 % E24 series	± 1 % E24/E96 series	± 5 % E24 series	± 1 % E24/E96 series	± 5 % E24 series	± 1 % E24/E96 series
Temperature Coefficient	± 200 ppm/K					
Climatic Category (LCT/UCT/Days)	55/155/56					
Rated Dissipation P_{70}	0.25 W		0.5 W		1 W	
Maximum Permissible Voltage:						
DC	1600 V		3500 V		10 000 V	
RMS	1150 V		2500 V		7000 V	
Basic Specification	IEC 60115-1 and IEC 60115-2					
Maximum Resistance Change at P_{70} for Resistance Range, ΔR max., After:						
Load (1000 h)	± (5 % R + 0.1 Ω)	± (1.5 % R + 0.1 Ω)	± (5 % R + 0.1 Ω)	± (1.5 % R + 0.1 Ω)	± (5 % R + 0.1 Ω)	± (1.5 % R + 0.1 Ω)
Climatic Tests	± (1.5 % R + 0.1 Ω)	± (1.5 % R + 0.1 Ω)	± (1.5 % R + 0.1 Ω)	± (1.5 % R + 0.1 Ω)	± (1.5 % R + 0.1 Ω)	± (1.5 % R + 0.1 Ω)
Resistance to Soldering Heat	± (1 % R + 0.1 Ω)	± (1 % R + 0.1 Ω)	± (1 % R + 0.1 Ω)	± (1 % R + 0.1 Ω)	± (1 % R + 0.1 Ω)	± (1 % R + 0.1 Ω)



12NC INFORMATION FOR HISTORICAL CODING REFERENCE ONLY

- The resistors have a 12 digit ordering code starting with 2306
- The next 4 or 5 digits indicate the resistor type and packaging
- For 5 % tolerance the last 3 digits indicate the resistance value:
 - The first 2 digits indicate the resistance value
 - The last digit indicates the resistance decade in accordance with table
- For 1 % tolerance the last 4 digits indicate the resistance value:
 - The first 3 digits indicate the resistance value
 - The last digit indicates the resistance decade in accordance with table

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE (5 %)	RESISTANCE DECADE (1 %)	LAST DIGIT
100 kΩ to 910 kΩ	100 kΩ to 976 kΩ	4
1 MΩ to 9.1 MΩ	1 MΩ to 9.76 MΩ	5
≥ 10 MΩ	≥ 10 MΩ	6

12NC Example

HVR25, 150 kΩ, ± 5 %, ammpack 1000 pieces is
2306 241 13154

12NC - resistor type and packaging						
DESCRIPTION			ORDERING CODE 2306			
			BANDOLIER IN AMMOPACK			BANDOLIER ON REEL
TYPE	TAPE WIDTH	TOLERANCE	500 UNITS	1000 UNITS	5000 UNITS	5000 UNITS
HVR25	52.5	± 5 %	-	241 13...	241 53...	241 23...
		± 1 %	-	241 8...	241 7...	241 6...
HVR37	52.5	± 5 %	-	242 13...	-	242 23...
		± 1 %	-	242 8...	-	242 6...
HVR68	63.0	± 5 %	244 13...	-	-	-
		± 1 %	244 8...	-	-	-

PART NUMBER AND PRODUCT DESCRIPTION (1)

PART NUMBER: HVR2500001503JA100

H	V	R	2	5	0	0	0	0	1	5	0	3	J	A	1	0	0
MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE			TOLERANCE	PACKAGING (2)	SPECIAL									
HVR2500 HVR3700 HVR6800	0 = Neutral	0 = Standard	3 digit value 1 digit multiplier MULTIPLIER 3 = *10 ³ 4 = *10 ⁴ 5 = *10 ⁵			F = ± 1 % J = ± 5 %	A1 A5 R5 AC	Up to 2 digits 00 = Standard									

PRODUCT DESCRIPTION: HVR25 5 % A1 150K

HVR25	5 %	A1	150K
MODEL	TOLERANCE	PACKAGING (2)	RESISTANCE VALUE
HVR25 HVR37 HVR68	± 1 % ± 5 %	A1 A5 R5 AC	150K = 150 kΩ 4M64 = 4.64 MΩ

Notes:

- (1) The PART NUMBER is shown to facilitate the introduction of the unified part numbering system
(2) Please refer to table PACKAGING, see next page

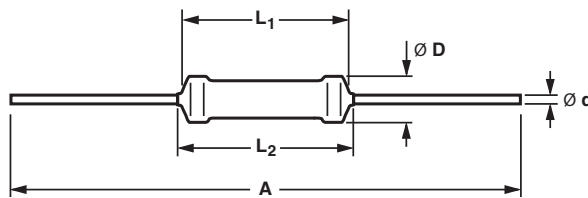
HVR25, HVR37, HVR68



Vishay BCcomponents High Ohmic (up to 33 MΩ), High Voltage (up to 10 kV) Metal Film Led Resistors

PACKAGING				
MODEL	REEL		BOX	
	PIECES	CODE	PIECES	CODE
HVR25	5000	R5	1000 5000	A1 A5
HVR37	5000	R5	1000	A1
HVR68	-	-	500	AC

DIMENSIONS

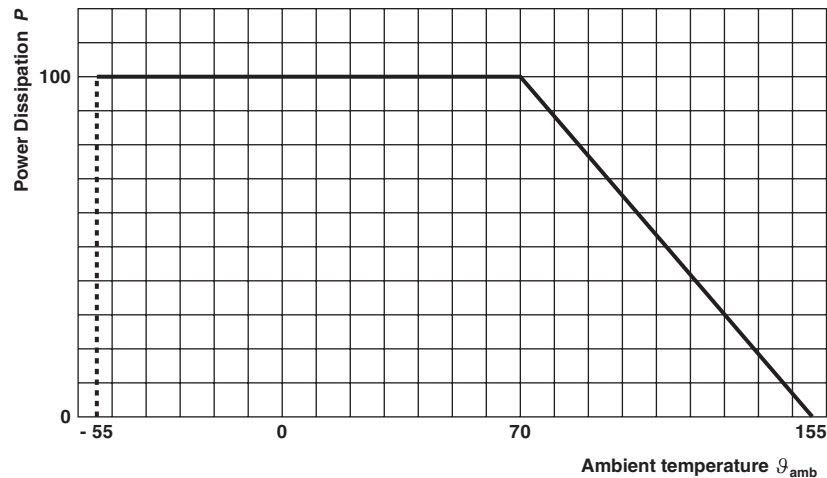


DIMENSIONS - resistor types, mass and relevant physical dimensions						
TYPE	L_1 min. (mm)	L_2 min. (mm)	D_{max} . (mm)	$\varnothing d$ (mm)	A (mm)	MASS (g)/ 100 pieces
HVR25	6.5	7.5	2.5	0.58 ± 0.05	52.5 ± 1.5	22
HVR37	10	12	4	0.80 ± 0.03	52.5 ± 1.5	50
HVR68	16.7	19.5	5.2	0.80 ± 0.03	63.0 ± 1.5	110

MARKING

The nominal resistance and tolerance are marked on the resistor using four or five colored bands in accordance with IEC 60062 "Color code for fixed resistors". Standard values of nominal resistance are taken from the E24 and E24/E96 series for resistors with a tolerance of $\pm 5\%$ or $\pm 1\%$ respectively. The values of the E24/E96 series are in accordance with IEC 60063. Yellow and grey are used instead of gold and silver because metal particles in the lacquer could affect high-voltage properties.

FUNCTIONAL PERFORMANCE



Derating - Standard Operation

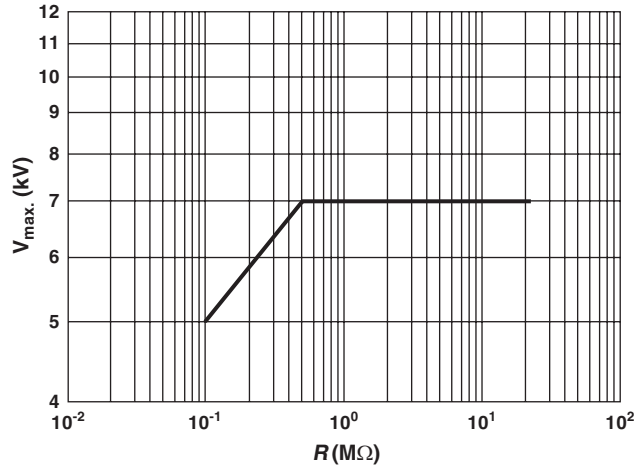
Maximum dissipation (P_{max}) in percentage of rated power as a function of ambient temperature (T_{amb})



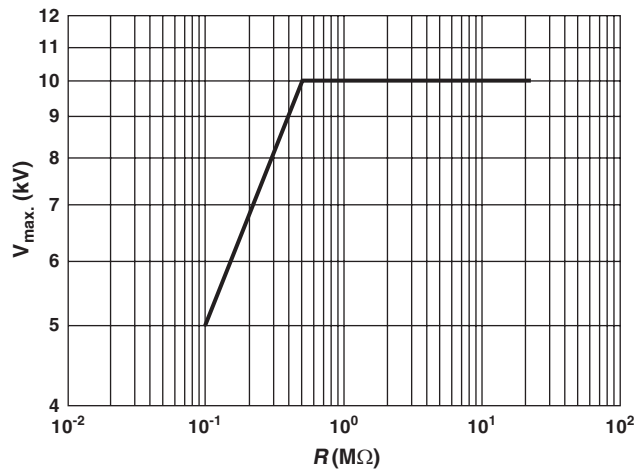
PULSE LOADING CAPABILITY

Note:

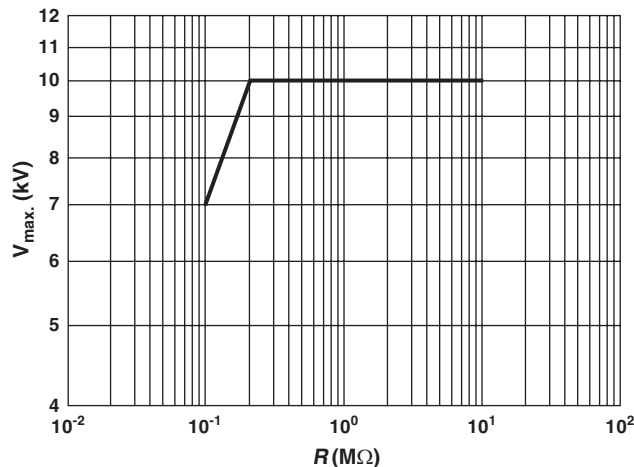
- Maximum allowed peak pulse voltage in accordance with “IEC 60065 chapter 14.1”; 50 discharges from a 1 nF capacitor charged to V_{max} ; 12 discharges/min



HVR25
 $\Delta R \pm (4.0 \% R + 0.1 \Omega)$



HVR37
For 5 % tolerance $\Delta R \pm (4.0 \% R + 0.1 \Omega)$
For 1 % tolerance $\Delta R \pm (2.0 \% R + 0.1 \Omega)$



HVR68
 $\Delta R \pm (2.0 \% R + 0.1 \Omega)$

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of IEC 60115-1, category 55/155/56 (rated temperature range - 55 to + 155 °C; damp heat, long term, 56 days) and along the lines of IEC 60068-2; "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmosphere conditions according to IEC 60068-1 subclause 5.3, unless otherwise specified. In some instances deviations from IEC recommendations were necessary for our specified method.

PERFORMANCE						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
				HVR25	HVR37	HVR68
4.8	-	Temperature coefficient	Between - 55 °C and + 155 °C	± 200 ppm/K		
4.25.1	-	Endurance at 70 °C	1000 h; loaded with Pn or V _{max} ; 1.5 h ON; 0.5 h OFF for 5 % tolerance for 1 % tolerance	$\pm (5 \% R + 0.1 \Omega)$ $\pm (1.5 \% R + 0.1 \Omega)$		
4.24	3 (Ca)	Damp heat, steady state	56 days; 40 °C; 90 % to 95 % RH loaded with 0.01 Pn for 5 % tolerance for 1 % tolerance	$\pm (5 \% R + 0.1 \Omega)$ $\pm (1.5 \% R + 0.1 \Omega)$		
4.23	2 (Ba) 30 (Db) 1 (Aa) 30 (Db)	Climatic sequence		$\pm (1.5 \% R + 0.1 \Omega)$		
4.23.2		Dry heat	16 h, 155 °C			
4.23.3		Damp heat, cyclic	24 h; 25 °C to 55 °C 90 % to 100 % RH; 1 cycle			
4.23.4		Cold	2 h, - 55 °C			
4.23.6		Damp heat, (accelerated) remaining cycles	5 days; 25 °C to 55 °C 90 to 100 % RH			
4.19	14 (Na)	Rapid change of temperature	30 min at LCT; 30 min at UCT; LCT = - 55 °C; UCT = 155 °C; 5 cycles	No visual damage $\pm (1 \% R + 0.1 \Omega)$		
4.13	-	Short time overload	Room temperature; dissipation 6.25 x Pn (voltage not more than 2 x limiting voltage, 10 000 V _{max}); 10 cycles 5 s ON and 45 s OFF for 5 % tolerance for 1 % tolerance	$\pm (2 \% R + 0.1 \Omega)$ $\pm (1 \% R + 0.1 \Omega)$		
4.12	-	Noise	"IEC 60195"	Max. 5 μ V/V	Max. 2.5 μ V/V	
4.16	21 (U)	Robustness of terminations:		No damage $\pm (1 \% R + 0.1 \Omega)$		
4.16.2	21 (Ua1)	Tensile all samples	Load 10 N; 10 s			
4.16.3	21 (Ub)	Bending half number of samples	Load 5 N; 4 x 90°			
4.16.4	21 (Uc)	Torsion other half of samples	3 x 360° in opposite direction			



PERFORMANCE						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
				HVR25	HVR37	HVR68
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 500 Hz; displacement 1.5 mm or acceleration 10 g; 6 h (3 x 2 h)	$\pm (1.0 \% R + 0.1 \Omega)$		
4.17	20 (Ta)	Solderability (after ageing)	16 h at 155 °C; immersed in flux 600, leads immersed 2 mm in solder bath at $(235 \pm 5) \text{ }^\circ\text{C}$ for $(2 \pm 0.5) \text{ s}$	Good tinning ($\geq 95 \%$ covered); no visible damage		
4.18	20 (Tb)	Resistance to soldering heat	Solder bath method; $(350 \pm 10) \text{ }^\circ\text{C}$; 6 mm from body 3 s	$\pm (1 \% R + 0.1 \Omega)$		
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol; MIL STD 202E	No visible damage		
4.6.11	-	Insulation resistance	500 V _{DC} during 1 min, V-block method	R_{ins} min. $10^4 \text{ M}\Omega$		
4.7	-	Voltage proof on insulation	700 V _{RMS} during 1 min, V-block method	No flashover or breakdown		

Surge Metal Film Leaded Resistor



A multi layer metal film is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned electrolytic copper wires are welded to the end-caps. The resistors are coated with a light blue non-flammable lacquer, which provides electrical, mechanical, and climatic protection.

The encapsulation is resistant to all cleaning solvents in accordance with "MIL-STD 202E, method 215" and "IEC 60068-2-45".

FEATURES

- Metal film technology
- High pulse load (up to 10 kV) capability
- Replacement for carbon-composition resistors
- Compatible with lead (Pb)-free and lead containing soldering processes
- Lead (Pb)-free and RoHS compliant



APPLICATIONS

- Automotive
- Telecommunication
- Industrial
- Medical equipment

TECHNICAL SPECIFICATIONS

DESCRIPTION	SR37
Resistance Range	220 Ω to 10 k Ω
Resistance Tolerance	$\pm 10\%$, $\pm 20\%$, E12 series
Temperature Coefficient	± 250 ppm/K
Climatic Category (LCT/UCT/Days)	55/155/56
Rated Dissipation P_{70}	0.5 W
Rated Voltage	$\sqrt{P_n \times R}$
Voltage Proof on Insulation	700 V
Basic Specification	IEC 60115-1 and IEC 60115-2
Maximum Resistance Change at P_{70} for Resistance Range, ΔR max., After:	
Load (1000 h)	$\pm (3\% R + 0.1 \Omega)$
Climatic Tests	$\pm (3\% R + 0.1 \Omega)$
Resistance to Soldering Heat	$\pm (1\% R + 0.1 \Omega)$
High Voltage Pulse Test for R-Value ≤ 4.7 k Ω , 10 kV; 1 nF; 50 x 12/Min	$\pm 20\%$

12NC INFORMATION FOR HISTORICAL CODING REFERENCE ONLY

- The resistors have a 12 digit ordering code starting with 2306
- The next 5 digits indicate the resistor type and packaging. The last 3 digits indicate resistance value in which:
 - The first 2 digits indicate the resistance value
 - The last digit indicates the resistance decade in accordance with table

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
220 Ω to 910 Ω	1
1 k Ω to 9.1 k Ω	2
10 k Ω	3

12NC Example

SR37, 1.5 k Ω , $\pm 10\%$, reel 5000 pieces is **2306 245 33152**

12NC - resistor type and packaging				
DESCRIPTION			ORDERING CODE 2306	
			BANDOLIER IN AMMOPACK	BANDOLIER ON REEL
TYPE	TAPE WIDTH	TOLERANCE	1000 UNITS	5000 UNITS
SR37	52.5	± 10 %	245 31....	245 33....
		± 20 %	245 11...	245 23...

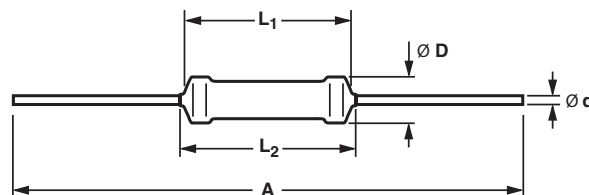
PART NUMBER AND PRODUCT DESCRIPTION (1)						
PART NUMBER: SR03700001501KR500						
S	R	0	3	7	0	0
0	0	0	0	1	5	0
1	K	R	5	0	0	
MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING (2)	SPECIAL
SR03700	0 = Neutral	0 = Standard	3 digit value 1 digit multiplier MULTIPLIER 3 = *10 ³ 4 = *10 ⁴ 5 = *10 ⁵	K = ± 10 % M = ± 20 %	A1 R5	Up to 2 digits 00 = Standard
PRODUCT DESCRIPTION: SR037 10 % R5 1K5						
SR037	10 %	R5	1K5			
MODEL	TOLERANCE	PACKAGING (2)	RESISTANCE VALUE			
SR03700	± 10 % ± 20 %	A1 R5	1K5 = 1.5 kΩ			

Notes:

(1) The PART NUMBER is shown to facilitate the introduction of the unified part numbering system

(2) Please refer to table PACKAGING, see next page

PACKAGING				
MODEL	REEL		BOX	
	PIECES	CODE	PIECES	CODE
SR37	5000	R5	1000	A1

DIMENSIONS


DIMENSIONS - resistor types, mass and relevant physical dimensions						
TYPE	L ₁ max. (mm)	L ₂ max. (mm)	D _{max.} (mm)	Ø d (mm)	A (mm)	MASS (g)/ 100 pieces
SR37	9.0	11.0	4.0	0.80 ± 0.03	52.5 ± 1.5	50.5



MARKING

The nominal resistance and tolerance are marked on the resistor using three colored bands for ± 20 % tolerance and four bands for ± 10 % tolerance in accordance with IEC 60062 “Color code for fixed resistors”. Standard values of nominal resistance are taken from the E12 series for resistors with a tolerance of ± 10 % or ± 20 %. The values of the E12 series are in accordance with IEC 60063.

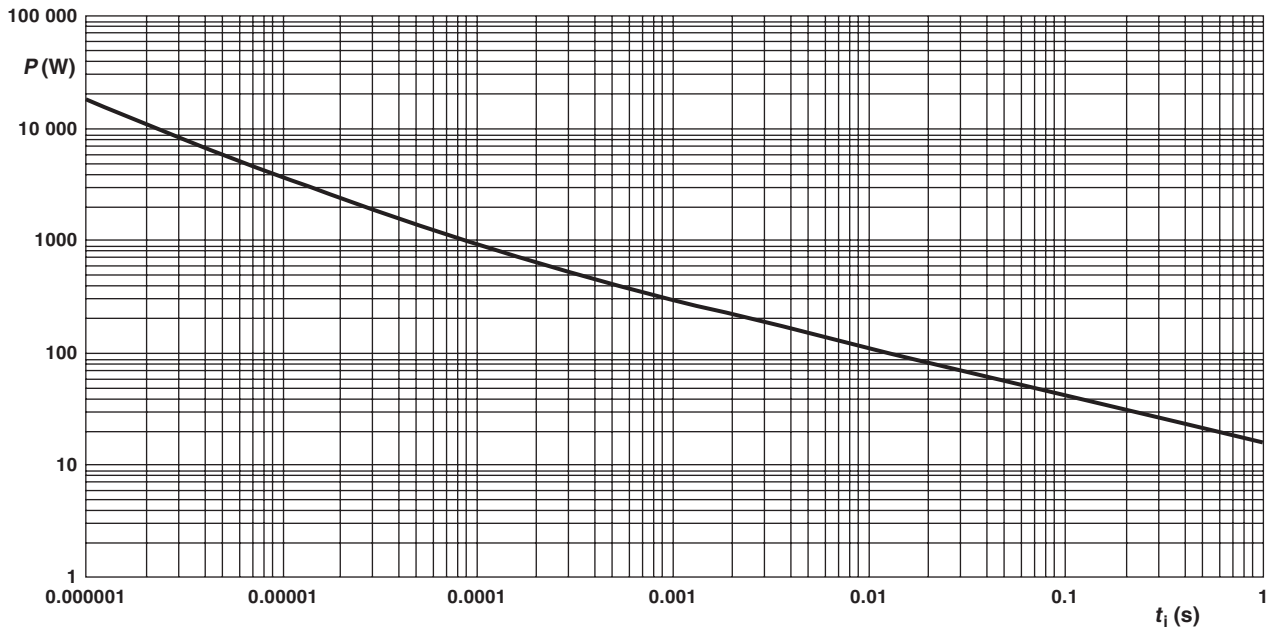
FUNCTIONAL PERFORMANCE



Derating - Standard Operation

Maximum dissipation (P_{max}) in percentage of rated power as a function of ambient temperature (T_{amb})

PULSE LOADING CAPABILITY



Pulse on a regular basis; maximum permissible peak pulse power (P_{max}) as a function of pulse duration (t_i) for single pulse condition

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of IEC 60115-1, category 55/155/56 (rated temperature range - 55 to + 155 °C; damp heat, steady state, 56 days) and along the lines of IEC 60068-2; “Recommended basic climatic and mechanical robustness testing procedure for electronic components” and under standard atmosphere conditions according to IEC 60068-1 subclause 5.3, unless otherwise specified. In some instances deviations from IEC applications were necessary for our specified method.

PERFORMANCE				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR) SR37
4.8	-	Temperature coefficient	Between - 55 °C and + 155 °C	± 250 ppm/K
4.25.1	-	Endurance at 70 °C	1000 h; loaded with Pn or V_{max} ; 1.5 h ON; 0.5 h OFF	$\pm (3 \% R + 0.1 \Omega)$
4.24	3 (Ca)	Damp heat, steady state	56 days; 40 °C; 90 % to 95 % RH loaded with 0.01 Pn	$\pm (3 \% R + 0.1 \Omega)$
4.23	2 (Ba)	Climatic sequence Dry heat	155 °C; 16 h dry heat	$\pm (3 \% R + 0.1 \Omega)$
4.23.2	30 (Db)	Damp heat (accelerated)	24 h; 25 °C to 55 °C; 90 % to 100 % RH 1 st cycle	
4.23.3	1 (Aa)	Cold	- 55 °C; 2 h	
4.23.4	30 (Db)	Damp heat, (accelerated) remaining cycles	5 days; 25 °C to 55 °C 90 % to 100 % RH	
4.23.6				
4.19	14 (Na)	Rapid change of temperature	30 min at LCT; 30 min at UCT; LCT = - 55 °C; UCT = 155 °C; 5 cycles	No visual damage $\pm (1 \% R + 0.1 \Omega)$
4.26	-	Active flammability "Cheese-cloth test"	5 x Pn (RMS) duration 5 min	No flaming of gauze cylinder
-	-	Passive flammability "Needle-flame test"	Application of test flame for 20 s	No ignition of product no ignition of under-layer burning time less than 30 s
-	-	High voltage pulse test	For R-value ≤ 4.7 k Ω , 10 kV; 1 nF; 50 x 12/min (in accordance with IEC 60065 14.1)	$\pm 20 \% R$
4.16	21 (U)	Robustness of terminations:	Load 10 N; 10 s Load 5 N; 4 x 90° 3 x 360° in opposite direction	No damage $\pm (1 \% R + 0.1 \Omega)$
4.16.2	21 (Ua1)	Tensile all samples		
4.16.3	21 (Ub)	Bending half number of samples		
4.16.4	21 (Uc)	Torsion other half of samples		
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 500 Hz; displacement 1.5 mm or acceleration 10 gms; 6 h (3 x 2 h)	$\pm (1 \% R + 0.1 \Omega)$
4.17	20 (Ta)	Solderability (after ageing)	16 h at 155 °C; immersed in flux 600, leads immersed 2 mm in solder bath at (235 \pm 5) °C for (2 \pm 0.5) s	Good tinning ($\geq 95 \%$ covered); no visible damage
4.18	20 (Tb)	Resistance to soldering heat	Solder bath method; (350 \pm 10) °C; 6 mm from body; for 3 s	$\pm (1 \% R + 0.1 \Omega)$
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol followed by brushing in accordance with MIL STD 202	No visible damage
4.6.1.1	-	Insulation resistance	500 V _{DC} during 1 min, V-block method	R_{ins} min. 10 ⁴ M Ω
4.7	-	Voltage proof on insulation	700 V _{RMS} during 1 min, V-block method	No flashover or breakdown

High Frequency (> 3 GHz) Leaded Resistors



MBA/SMA 0204 HF leaded thin film resistors for RF applications are the perfect choice in high frequency circuit designs; where the impedance change due to the parasitic inductance of regular and professional resistors can not be accepted. Typical applications are in the fields of telecommunication equipment and industrial electronics.

APPLICATIONS

- Telecommunication equipment
- Industrial electronics

FEATURES

- Speciality product for RF applications
- Low-inductance non-helical trimmed product
- Suitable for more than 3 GHz
- Resistance range: 1.5 Ω to 470 Ω
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



METRIC SIZE	
DIN:	0204
CECC:	A

TECHNICAL SPECIFICATIONS		
DESCRIPTION	MBA/SMA 0204 HF	
CECC Size	A	
Resistance Range	1.5 Ω to 470 Ω	
Resistance Tolerance	± 1 %; ± 2 %	
Temperature Coefficient	± 50 ppm/K	
Operation Mode	long term	standard
Climatic Category (LCT/UCT/Days)	55/125/56	55/155/56
Rated Dissipation, P_{70}	0.25 W	0.4 W
Operating Voltage, U_{max} AC/DC	limited by P_{70}	
Film Temperature	125 °C	155 °C
Max. Resistance Change at P_{70} for Resistance Range, $\Delta R/R$ max., After:	1.5 Ω to 470 Ω	
1000 h	≤ 0.25 %	≤ 0.5 %
8000 h	≤ 0.5 %	≤ 1.0 %
225 000 h	≤ 1.5 %	-
Specified Lifetime	225 000 h	8000 h
Permissible Voltage Against Ambient:		
1 Min; U_{ins}	300 V	
Continuous	75 V	
Failure Rate	≤ 0.7 x 10 ⁻⁹ /h	

PART NUMBER AND PRODUCT DESCRIPTION																	
PART NUMBER: MBA0204AC5109GCT00																	
M	B	A	0	2	0	4	A	C	5	1	0	9	G	C	T	0	0
MODEL/SIZE		SPECIAL CHARACTER		TCR/MATERIAL		VALUE		TOLERANCE		PACKAGING (1)		SPECIAL					
MBA0204 = MBA/SMA 0204		A = HF High Frequency		C = 50 ppm		3 digit value 1 digit multiplier MULTIPLIER 8 = *10 ⁻² 9 = *10 ⁻¹ 0 = *10 ⁰		F = ± 1.0 % G = ± 2.0 %		CT C1 RP		00 = Standard					
PRODUCT DESCRIPTION: MBA/SMA 0204-50 2% HF CT 51R0																	
MBA/SMA 0204	-	50	2%	HF	CT	51R0											
MODEL/SIZE		TCR	TOLERANCE	SUFFIX	PACKAGING (1)	RESISTANCE VALUE											
MBA/SMA 0204		50 ppm	± 1.0 % ± 2.0 %	HF	CT C1 RP	51R0 = 51 Ω											

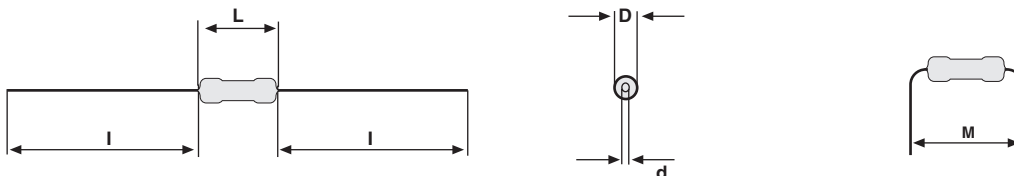
Notes:

(1) Please refer to table PACKAGING for complete information

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products

PACKAGING				
MODEL	REEL		BOX	
	PIECES	CODE	PIECES	CODE
MBA/SMA 0204	5000	RP	1000 5000	C1 CT

DIMENSIONS



DIMENSIONS - leaded resistor types, mass and relevant physical dimensions						
TYPE	D _{max.} (mm)	L _{max.} (mm)	d _{nom.} (mm)	l _{min.} (mm)	M _{min.} (mm)	MASS (mg)
MBA/SMA 0204 HF	1.6	3.6	0.5	29.0	5.0	125

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE		
DESCRIPTION	RESISTANCE VALUE (2)	
TCR	TOLERANCE	MBA/SMA 0204 HF
± 50 ppm/K	± 1 %; ± 2 %	1.5 Ω to 470 Ω; 50 Ω

Note:

(2) Resistance values to be selected for ± 1 % from the E24/E96 series and for ± 2 % from E24 series

DESCRIPTION

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 (85 % Al_2O_3) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the metallised rods. A special laser is used to achieve the target value by smoothly cutting a low-inductivity non-helical groove in the resistive layer without damaging the ceramics. Connecting wires of electrolytic copper plated with 100 % pure tin are welded to the termination caps. The resistors are covered by protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating. Four colour code rings designate the resistance value and tolerance in accordance with **IEC 60062**. Additional black dots near the 3rd colour ring identify the special HF product.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are stuck directly on the adhesive tapes in accordance with **IEC 60286-1**.

ASSEMBLY

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. Excellent solderability is proven, even after extended storage. They are suitable for automatic soldering using wave or dipping. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. The immunity of the plating against tin whisker growth has been proven under extensive testing. All products comply with the CEFIC-EECA-EICTA list of legal restrictions on hazardous substances. This includes full compatibility with the following directives:

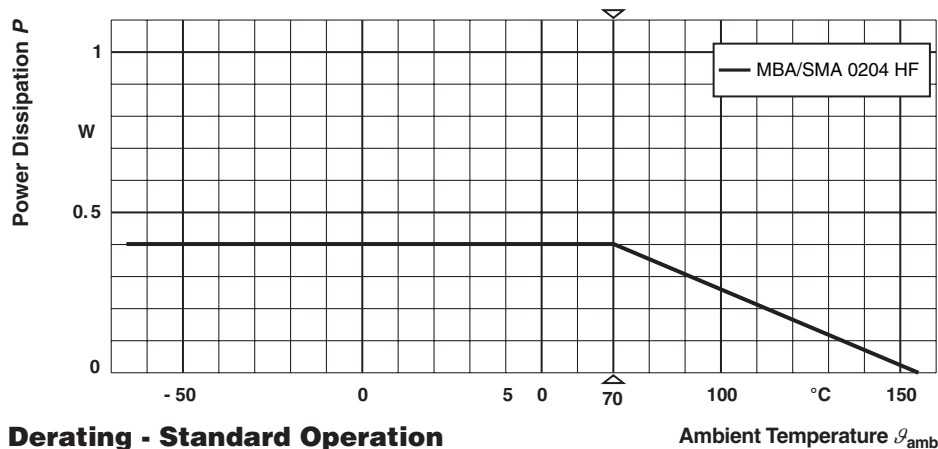
- 2000/53/EC End of Vehicle Life Directive (ELV)
- 2000/53/EC Annex II to End of Vehicle Life Directive (ELV II)
- 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electrical Equipment Directive (WEEE)

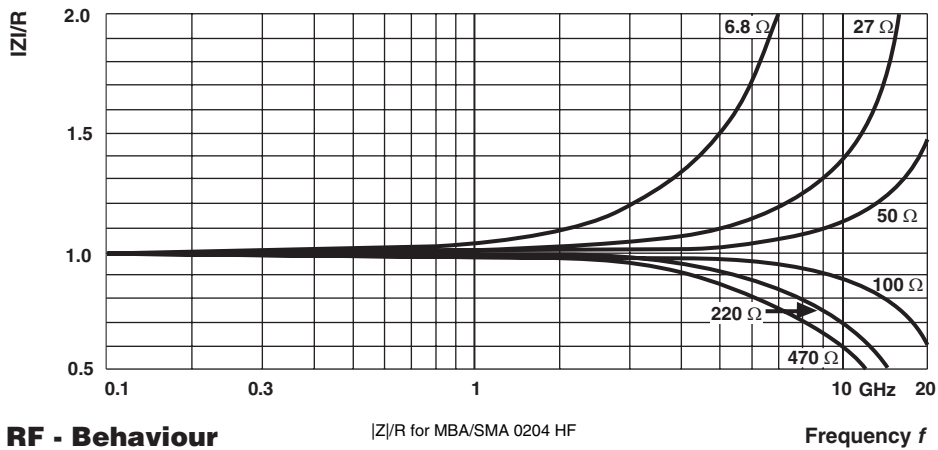
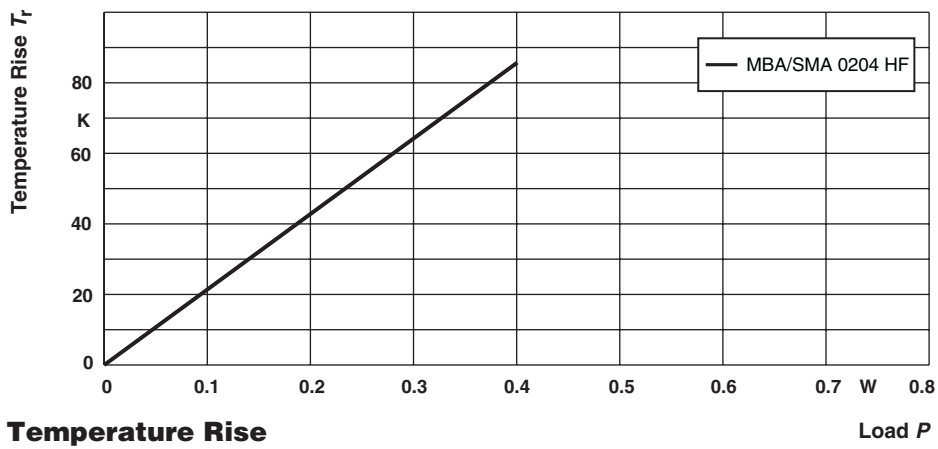
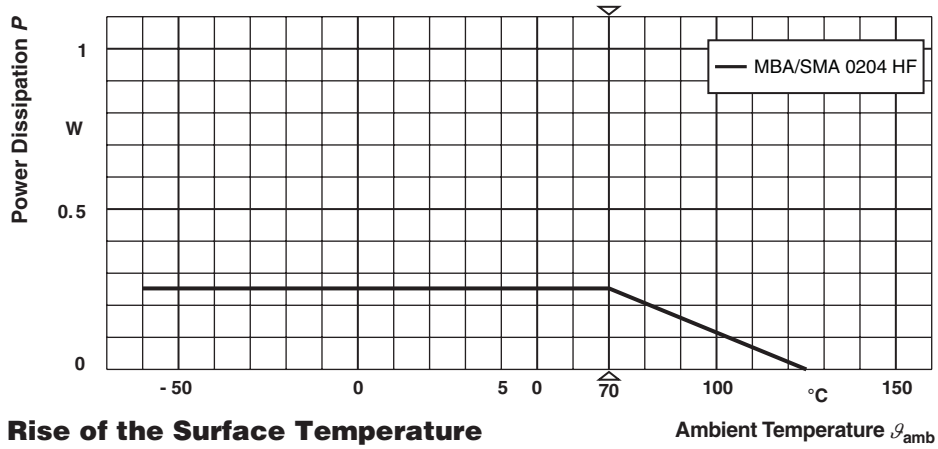
APPROVALS

Where applicable, the resistors are tested in accordance with **CECC 40101-806** which refers to **EN 60115-1** and **EN 140100**.

Vishay BEYSCHLAG has achieved “**Approval of Manufacturer**” in accordance with **EN 100114-1**.

FUNCTIONAL PERFORMANCE







TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the following specifications:

EN 140 000/IEC 60115-1, Generic specification (includes tests)

EN 140100/IEC 60115-2, Sectional specification (includes schedule for qualification approval)

CECC 40101-806, Detail specification (includes schedule for conformance inspection)

The following table contains the applicable tests selected from the documents listed above.

The tests are carried out in accordance with IEC 60068 and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3. Climatic category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days) is valid.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 45 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

For testing the components are mounted on a test board in accordance with IEC 60115-1, 4.31 unless otherwise specified.

In the Test Procedures and Requirements table only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2; a short description of the test procedure is also given.

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR max.)
			stability for product types: MBA/SMA 0204 HF	1.5 Ω to 470 Ω
4.5	-	resistance		$\pm 1\%$; $\pm 2\%$
4.8.4.2	-	temperature coefficient	at 20/LCT/20 °C and 20/UCT/20 °C	± 50 ppm/K
4.25.1	-	endurance at 70 °C: standard operation mode	$U = \sqrt{P_{70}} \times \bar{R}$ or $U = U_{max.}$; 1.5 h ON; 0.5 h OFF 70 °C; 1000 h 70 °C; 8000 h	$\pm (0.5\% R + 0.05 \Omega)$ $\pm (1\% R + 0.1 \Omega)$
	-	endurance at 70 °C: long term operation mode	$U = \sqrt{P_{70}} \times \bar{R}$ or $U = U_{max.}$; 1.5 h ON; 0.5 h OFF 70 °C; 1000 h 70 °C; 8000 h	$\pm (0.25\% R + 0.05 \Omega)$ $\pm (0.5\% R + 0.05 \Omega)$
4.25.3	-	endurance at upper category temperature	 125 °C; 1000 h 155 °C; 1000 h	$\pm (0.25\% R + 0.05 \Omega)$ $\pm (0.5\% R + 0.05 \Omega)$
4.24	78 (Cab)	damp heat, steady state	(40 \pm 2) °C; 56 days; (93 \pm 3) % RH	$\pm (0.5\% R + 0.05 \Omega)$



TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR max.)
			stability for product types: MBA/SMA 0204 HF	1.5 Ω to 470 Ω
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	155 °C; 16 h	
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; 90 to 100 % RH; 1 cycle	
4.23.4	1 (Aa)	cold	- 55 °C; 2 h	
4.23.5	13 (M)	low air pressure	8.5 kPa; 2 h; 15 °C to 35 °C	
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 % to 100 % RH; 5 cycles	$\pm (0.5 \% R + 0.05 \Omega)$ no visible damage
-	1 (Aa)	cold	- 55 °C; 2 h	$\pm (0.1 \% R + 0.01 \Omega)$
4.13	-	short time overload	room temperature; $U = 2.5 \times \sqrt{P_{70}} \times R$ or $U = 2 \times U_{max.}; 5 \text{ s}$	$\pm (0.1 \% R + 0.01 \Omega)$ no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	$\pm (0.1 \% R + 0.01 \Omega)$ no visible damage
4.29	45 (XA)	component solvent resistance	isopropyl alcohol + 23 °C; toothbrush method	marking legible; no visible damage
4.18.2	20 (Tb)	resistance to soldering heat	unmounted components; (260 \pm 5) °C; (10 \pm 1) s	$\pm (0.1 \% R + 0.01 \Omega)$ no visible damage
4.17	20 (Ta)	solderability	+ 235 °C; 2 s; solder bath method	good tinning ($\geq 95 \% R$ covered); no visible damage
4.22	6 (B4)	vibration	6 h; 10 to 2000 Hz 1.5 mm or 196 m/s ²	$\pm (0.1 \% R + 0.01 \Omega)$
4.16	21 (Ua ₁) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	$\pm (0.1 \% R + 0.01 \Omega)$; no visible damage
4.7	-	voltage proof	$U_{RMS} = U_{ins}; 60 \text{ s}$	no flashover or breakdown

12NC INFORMATION

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
1 Ω to 9.99 Ω	8
10 Ω to 99.9 Ω	9
100 Ω to 999 Ω	1

Ordering Example (For historical coding reference of MBA 0204 HF)

The ordering code of a MBA 0204 HF resistor, value 51 Ω and TCR 50 with $\pm 2 \%$ tolerance, supplied on bandolier ammpack, in a box units is: 2312 908 05109.

12NC CODE FOR HISTORICAL CODING REFERENCE OF MBA 0204 HF				
DESCRIPTION			ORDERING CODE 2312	
			BANDOLIER IN BOX AMMPACK	
TYPE	TCR	TOL.	C1 1000 units	CT 5000 units
MBA 0204 HF	$\pm 50 \text{ ppm/K}$	$\pm 2 \%$	903 0...	908 0...

Metal Film Resistors, High Positive TCR (4500 ± 500 for size 0207)



FEATURES

- High positive temperature coefficient (4500 ± 500 for size 0207)
- Stable film structure
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- Temperature sensitive overload limiting
- Suitable for measuring techniques and temperature sensing applications



STANDARD ELECTRICAL SPECIFICATIONS

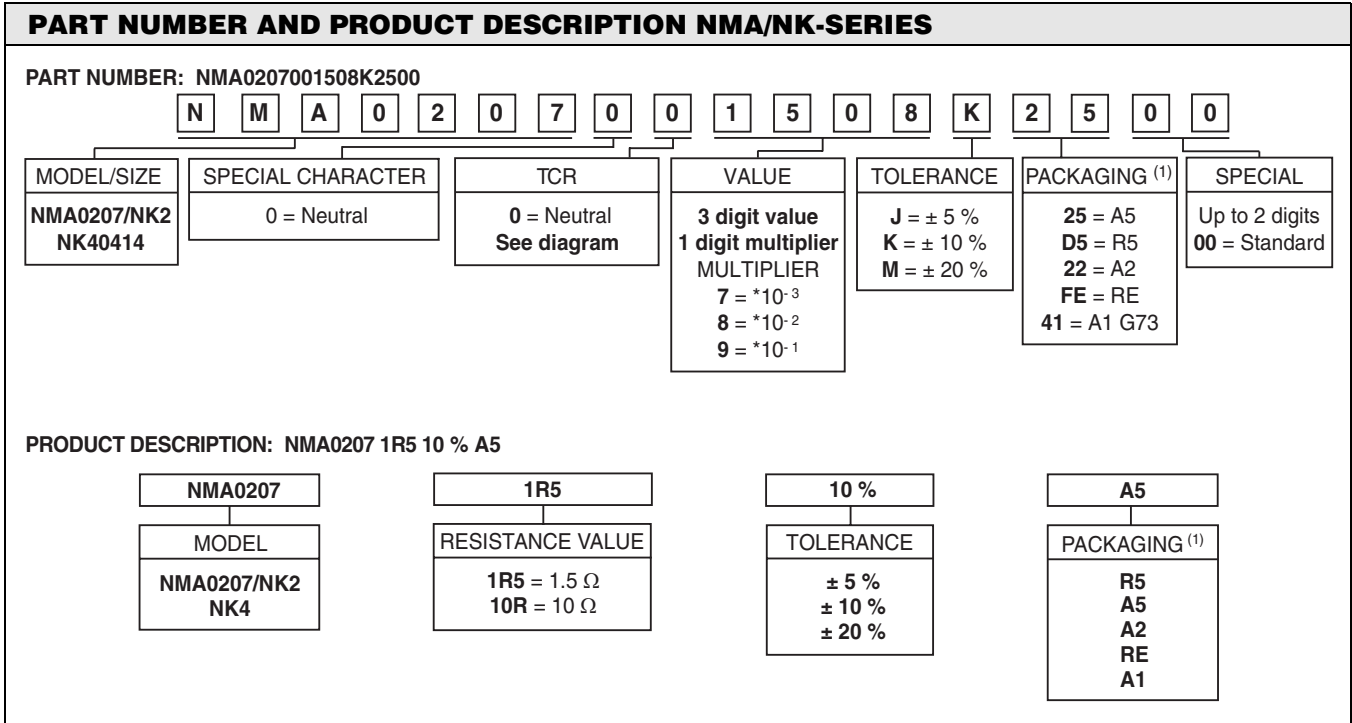
MODEL	POWER RATING $P_{70\text{ }^{\circ}\text{C}}$ W	TEMPERATURE COEFFICIENT ppm/K	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
NMA0207/NK2	0.4	4500 ± 500	$\pm 5; \pm 10$	R10 - 47R	24
NK4	0.7	see graph	± 5 $\pm 10; \pm 20$	1R0 - 47R R10 - 47R	24

Notes:

- Coating: 0207: green, NK4: brown
- Further values on request
- Marking: 5th band white
- Rated voltage $\sqrt{P \times R}$

TECHNICAL SPECIFICATIONS

PARAMETER	UNIT	NMA0207 NK2	NK4
Rated Dissipation at 70 °C	W	0.4	0.7
Insulation Voltage (1 Min)	V_{eff}	> 700	> 500
Insulation Resistance	Ω	$\geq 10^{11}$	$\geq 10^{10}$
Thermal Resistance	K/W	≤ 220	≤ 130
Category Temperature Range	$^{\circ}\text{C}$	- 55 to + 155	- 55 to + 155
Terminal Strength, Axial	N	> 50	> 50
Failure Rate	$10^{-9}/\text{h}$	< 10	< 10
Weight	g	0.22	0.7



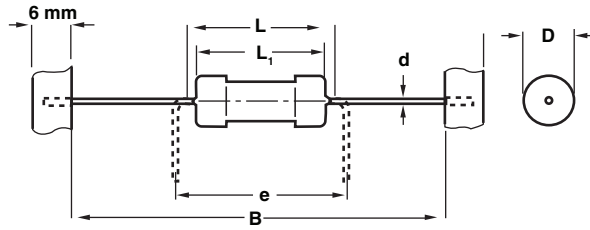
Notes:

⁽¹⁾ Please refer to table PACKAGING, see next page.

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products.

PACKAGING						
MODEL	REEL			BOX		
	PIECES/REEL	CODE	M.O.Q PACKAGING UNITS	PIECES/BOX	CODE	M.O.Q. PACKAGING UNITS
NMA0207/NK2	5000	R5	1	2000 5000	A2 A5	2 1
NK4	2500	RE	1	1000	A1	2

DIMENSIONS



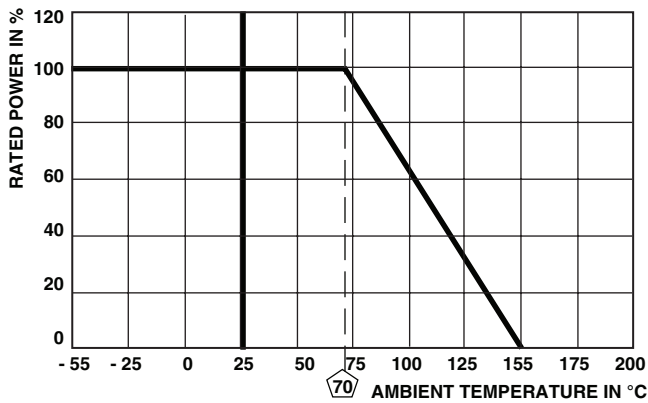
Notes:

- Taping in acc. with IEC60286-1
- d according to IEC60301
- D and L measured in acc. with IEC60294

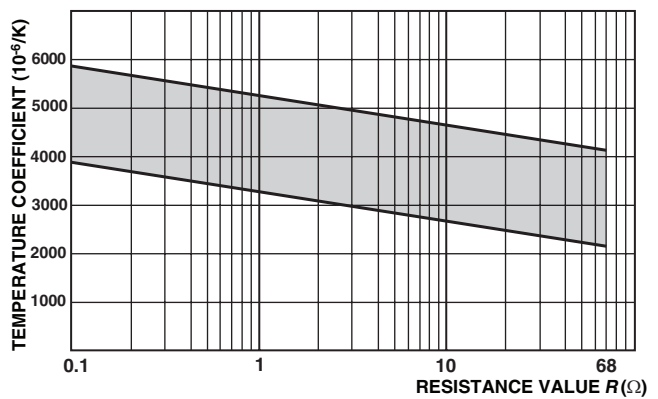
MODEL	DIMENSIONS [in millimeters]					
	D _{max.}	L	L ₁ max.	B	d	e
NMA0207/NK2	2.5 _{-0.3}	6.3 _{-0.5}	7.0	53 ± 1 ⁽¹⁾	0.6	7.5
NK4	4.1 _{-0.5}	12.0 _{-1.5}	16.0	73 ± 1	0.8	15.0

Note:

(1) Also available in 26 mm tape spacing



DERATING



TEMPERATURE COEFFICIENT

**Metal Film Resistors,
High Positive TCR (4500 ± 500 for size 0207)****Vishay Draloric**

PERFORMANCE		
TEST	CONDITIONS OF TEST	TEST RESULTS
Endurance Test IEC 60115-1 4.25.1	1000 h at 70 °C, 1.5 h ON, 0.5 h OFF	≤ ± 1.0 %
Endurance at UCT IEC 60115-1 4.25.3	1000 h at 155 °C without load	≤ ± 1.0 %
Damp Heat Steady State IEC 60115-1 4.24; IEC 60068-2-3	56 days at 40 °C and 93 % relative humidity	≤ ± 1.0 %
Resistance to Soldering Heat IEC 60115-1 4.18, IEC 60068-2-20	10 s at 260 °C solder bath temperature	≤ ± 0.25 %
Robustness of Terminations IEC 60115-1 4.16	Tensile, bending and torsion	≤ ± 0.25 %

APPLICABLE SPECIFICATIONS
<ul style="list-style-type: none">• CECC 40000/40100• EN 1400/IEC60115-1





Metal Oxide Film Resistors

High Power Dissipation



High Temperature Coatings



Non Inflammable



Contents

SXA	170
RJU	174
WK/WR	176
RNX.....	180
ROX	182
RDX.....	184

Metal Oxide Resistors, Standard



FEATURES

- Rugged metal oxide film
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- High power dissipation (up to 4 W)
- High temperature coating (refer power derating graph)
- Used in applications with high endurance demands



STANDARD ELECTRICAL SPECIFICATIONS						
MODEL	POWER RATING $P_{70\text{ }^\circ\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX. V_{Ξ}	TEMPERATURE COEFFICIENT ppm/K	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
SXA0411	0.7	$\sqrt{P \times R}$	300	± 2 ± 5	1R0 - 9R53 R16 - 9R53	48 24
SXA0411	1.0	350	300	± 2 ± 5	10R - 100K 10R - 100K	48 24
SXA0617	1.5	$\sqrt{P \times R}$	300	± 2 ± 5	1R0 - 9R53 R16 - 9R53	48 24
SXA0617	2.0	500	300	± 2 ± 5	10R - 100K 10R - 100K	48 24
SXA0922	4.0	500	300	± 2 ± 5	10R - 68K 5R1 - 68K	48 24

Notes:

- TCR 200 ppm/°C on request
- Coating: grey
- Marking: SXA0411 and SXA0617 color code (no TCR band); SXA0922 print marked

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER: SXA0411081802GDE00

S	X	A	0	4	1	1	0	8	1	8	0	2	G	D	E	0	0
MODEL SXA	SIZE 0411 0617 0922	SPECIAL CHARACTER 0 = Neutral	TCR 8 = ± 300 ppm/K			VALUE 3 digit value 1 digit multiplier MULTIPLIER 7 = $\times 10^{-3}$ 8 = $\times 10^{-2}$ 9 = $\times 10^{-1}$ 0 = $\times 10^0$ 1 = $\times 10^1$ 2 = $\times 10^2$ 3 = $\times 10^3$			TOLERANCE G = $\pm 2\%$ J = $\pm 5\%$		PACKAGING (1) 21 = A1 (G53) 41 = A1 (G73) 2C = AC 2B = AB DE = RE (G53) FE = RE (G73) H1 = R1 DC = RC			SPECIAL Up to 2 digits 00 = Standard			

PRODUCT DESCRIPTION: SXA0411 300 18 K 2 % REG53

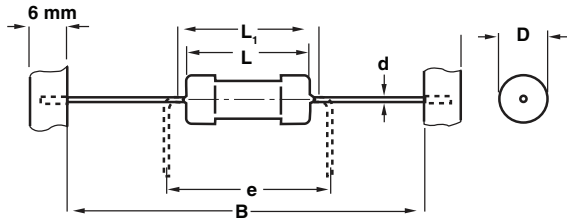
SXA0411 MODEL SXA0411 SXA0617 SXA0922	300 TCR ± 300 ppm/K	18 K RESISTANCE VALUE 49K9 = 49.9 k Ω 50R1 = 50.1 Ω	2 % TOLERANCE $\pm 2\%$ $\pm 5\%$	REG53 PACKAGING (1) A1G53 A1G73 AC AB REG53 REG73 R1 RC
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Notes:

(1) Please refer to table PACKAGING, see next page

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products

DIMENSIONS



MODEL	DIMENSIONS [in millimeters]					
	D	L	L _{1 max.}	B	d	e
SXA0411	3.8 - 0.4	11.0 - 0.6	14.0	73 ± 1 ⁽¹⁾	0.7	12.5
SXA0617	5.2 - 0.5	15.8 - 0.8	19.8	83 ± 1 ⁽¹⁾	0.8	17.5
SXA0922	8.4 - 0.6	22.2 - 0.9	26.2	83 ± 1	0.8	25.0

Notes:

- Taping in acc. with IEC60286
- D and L measured in acc. with IEC60294
- d according to IEC60301

Note:

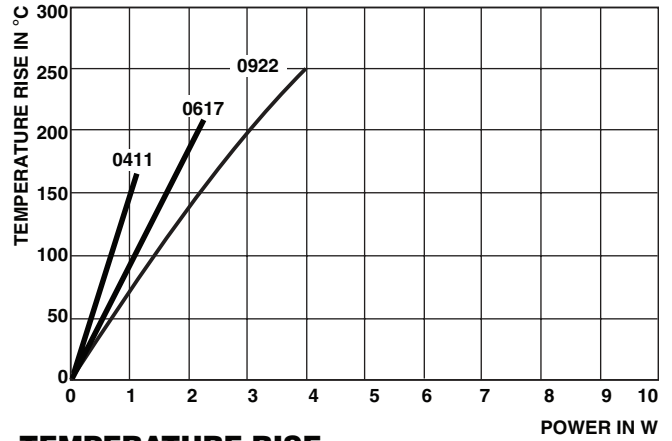
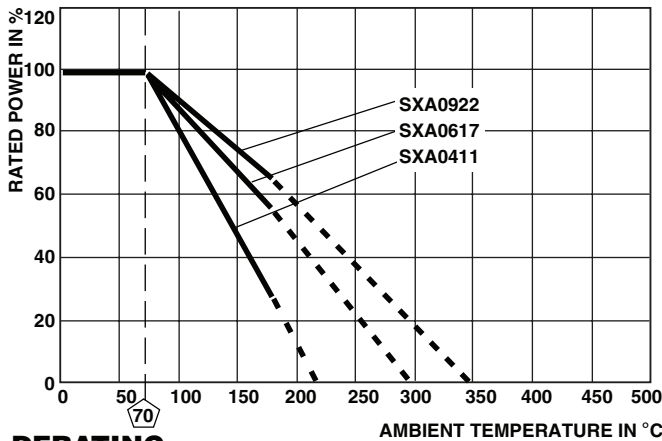
⁽¹⁾ Also available in 53 mm tape spacing

TECHNICAL SPECIFICATIONS

PARAMETER	UNIT	SXA0411		SXA0617		SXA0922
Rated Dissipation at 70 °C	W	0.7	1	1.5	2	4
Limiting Element Voltage ⁽²⁾	V _≅	≤ 350		≤ 500		≤ 500
Insulation Voltage (1 Min)	V _{eff}	> 600		> 600		> 600
Thermal Resistance	K/W	≤ 150		≤ 110		≤ 70
Insulation Resistance	Ω	≥ 10 ¹¹				
Category Temperature Range	°C	- 55 to + 175				
Terminal Strength, Axial	N	> 60		> 80		> 80
Failure Rated	10 ⁻⁸ /h	< 3				
Weight	g	0.52		1.1		3.2

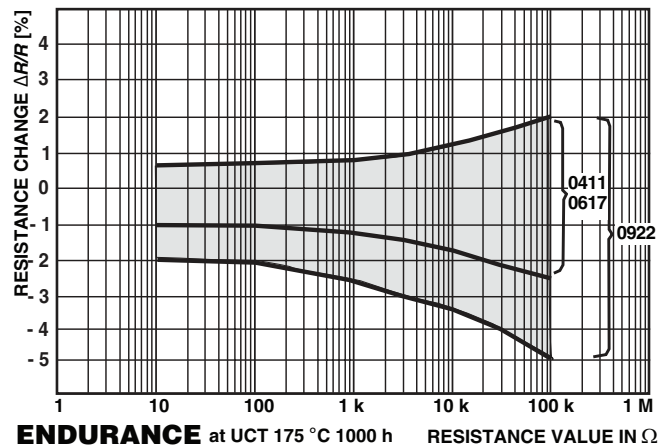
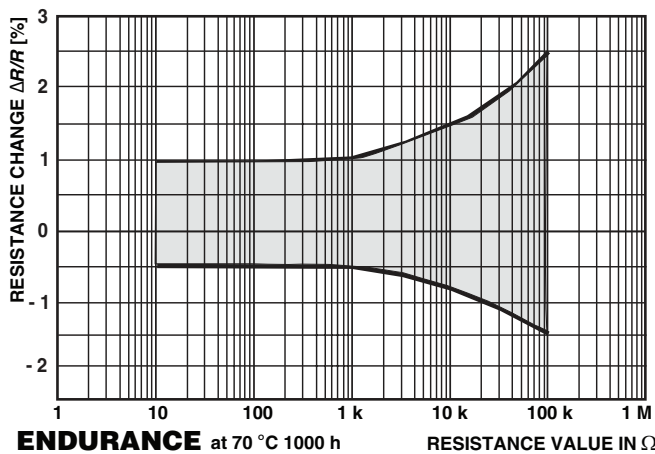
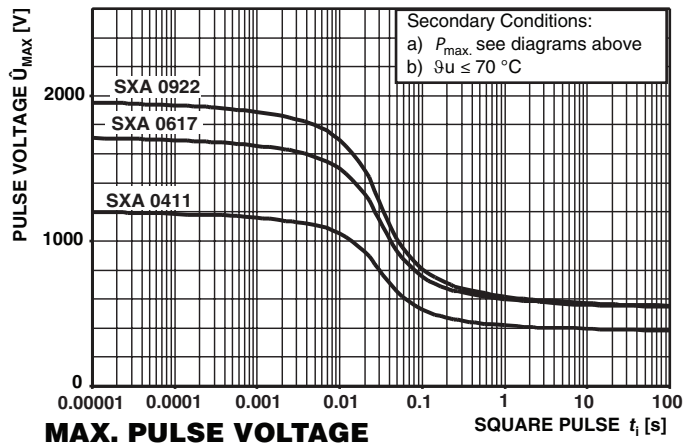
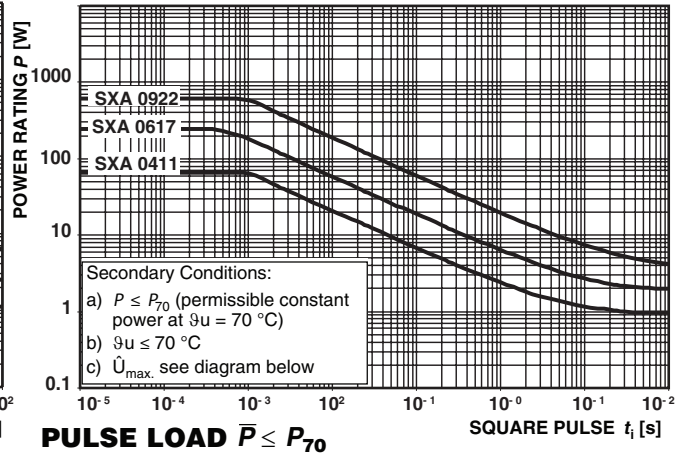
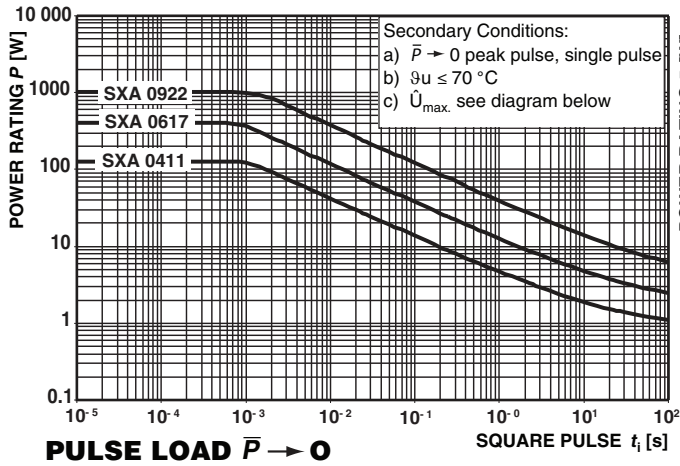
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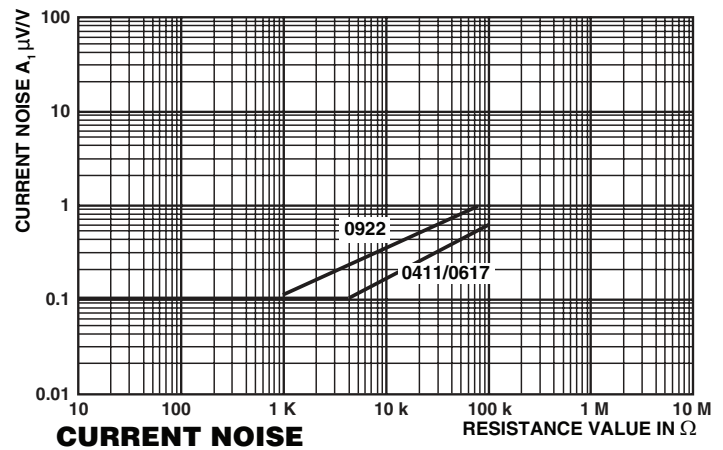
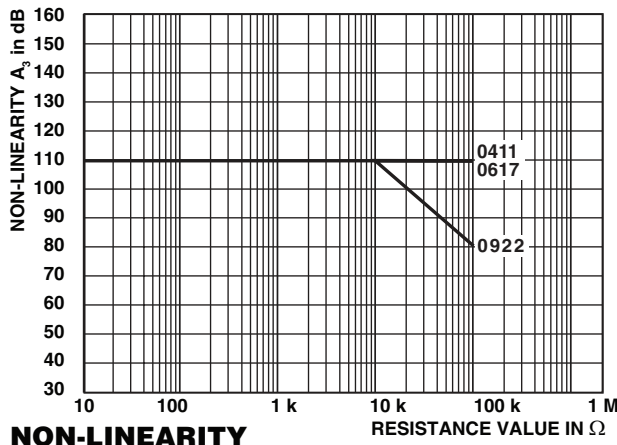
⁽²⁾ Rated Voltage $\sqrt{P \times R}$



PACKAGING

MODEL	REEL			BOX		
	PIECES/REEL	CODE	MIN. ORDER QTY PACKAGING UNITS	PIECES/BOX	CODE	MIN. ORDER QTY PACKAGING UNITS
SXA0411	2500	RE	1	1000	A1	1
SXA0617	1000	R1	2	500	AC	2
SXA0922	500	RC	2	250	AB	4





PERFORMANCE			
TEST	CONDITIONS OF TEST	REQUIREMENTS ⁽¹⁾	
		0411/0617	0922
Endurance at 70 °C IEC 60115-1 4.25.1	1000 h at 70 °C 1.5 h ON, 0.5 h OFF 8000 h at 70 °C 1.5 h ON, 0.5 h OFF	≤ ± 2.5 % ≤ ± 5.0	≤ ± 5.0 % ≤ ± 10 %
Endurance at UCT IEC60115-1 4.25.3	1000 h at 175 °C without load 8000 h at 175 °C without load	≤ ± 2.5 % ≤ ± 5.0 %	
Overload Test IEC 60115-1 4.13	Short time overload at 2.5 x rated power or twice the limiting voltage for 5 s	≤ ± 0.5 %	
Thermal Shock IEC 60115-1 4.19 IEC60068-2-14	Rapid change between upper and lower category temperature	≤ ± 0.5 %	
Climatic Sequence IEC60115-1 4.23	Dry heat, damp heat cyclic, cold, low air pressure	≤ ± 1.0 %	
Damp Heat Steady State IEC 60115-1 4.18 IEC60068-2-3	56 days at 40 °C and 93 % relative humidity and U = 0.1 x rated power	≤ ± 1.0 %	
Resistance to Soldering Heat IEC 60115-1 4.18 IEC60068-2-20	10 s at 260 °C solder bath temperature	≤ ± 0.25 %	
Robustness of Terminations IEC 60115-1 4.16	Tensile, bending and torsion	≤ ± 0.25 %	
Vibration IEC 60115-1 4.22	0.75 mm or 10 g, 10 Hz - 500 Hz	≤ ± 0.25 %	

Note:

(1) For a resistance range from 10 Ω to 100 kΩ

APPLICABLE SPECIFICATIONS

- CECC 40000
- EN 140 000/IEC 60115-1

Metal Oxide Resistors, Special Purpose High Power, Ultra High Value



FEATURES

- Wattages to 400 W at + 25 °C
- Derated to 0 at + 230 °C
- Voltage testing to 100 kV
- Tolerances: ± 1 %, ± 2 %, ± 5 %, ± 10 %
- Two terminal styles, Style 3 - Tab Terminal and Style 4 - Ferrule Terminal
- ± 200 ppm/°C and ± 100 ppm/°C available, measured between + 25 °C and + 125 °C
- Coating: Blue flameproof

STANDARD ELECTRICAL SPECIFICATIONS				
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{25\text{ }^\circ\text{C}}$ W	VOLTAGE RATING	RESISTANCE RANGE Ω
RJU040	RJU-40	40	25 kV	1K0 - 1G0
RJU050	RJU-50	50	33 kV	1K0 - 1G0
RJU070	RJU-70	70	40 kV	1K0 - 1G0
RJU095	RJU-95	95	35 kV	1K0 - 1G0
RJU095..1	RJU-95-1	95	35 kV	1K0 - 1G0
RJU140	RJU-140	140	65 kV	1K0 - 1G0
RJU140..1	RJU-140-1	140	65 kV	1K0 - 1G0
RJU275	RJU-275	275	90 kV	100K - 1G0
RJU275..1	RJU-275-1	275	90 kV	100K - 1G0
RJU150	RJU-150	150	40 kV	100K - 1G0
RJU150..1	RJU-150-1	150	40 kV	100K - 1G0
RJU400	RJU-400	400	125 kV	100K - 1G0
RJU400..1	RJU-400-1	400	125 kV	100K - 1G0

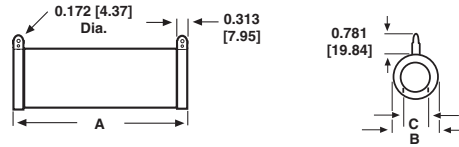
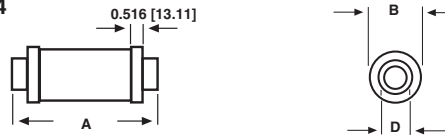
Note:

- All resistance values are calibrated at 100 VDC. Calibration at other voltages upon request.

MARKING	
	- DALE - Model - Value - Tolerance - Date code

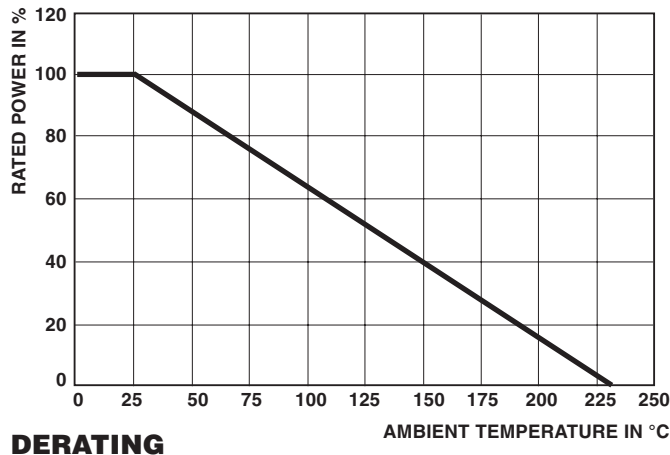
GLOBAL PART NUMBER INFORMATION																	
New Global Part Numbering: RJU0952M50KKF071 (preferred part numbering format)																	
R	J	U	0	9	5	2	M	5	0	K	K	F	0	7	1		
GLOBAL MODEL <small>(see Standard Electrical Specification Table)</small>	RESISTANCE VALUE K = Thousand M = Million G = Billion 1K00 = 1.0 kΩ 10M0 = 10 MΩ 1G00 = 1.0 GΩ		TOLERANCE CODE F = ± 1 % G = ± 2 % J = ± 5 % K = ± 10 %		TEMP. COEFFICIENT K = 100 ppm N = 200 ppm		PACKAGING E07 = Lead (Pb)-free, Foam F07 = Tin/Lead, Foam		SPECIAL Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable 1 = Ferrule Terminal								
Historical Part Number: RJU-95-12M50KK (will continue to be accepted)																	
RJU-95-1	2M50	K	K	F07													
HISTORICAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	TEMP. COEFFICIENT	PACKAGING													

DIMENSIONS in inches [millimeters]

Style 3

Style 4


GLOBAL MODEL	STYLE	A	B (1)	C	D
RJU040	3	4.500 [114.30]	0.750 [19.05]	0.500 [12.70]	N/A
RJU050	3	6.000 [152.40]	0.750 [19.05]	0.500 [12.70]	N/A
RJU070	3	8.000 [203.20]	0.750 [19.05]	0.500 [12.70]	N/A
RJU095	3	6.500 [165.10]	1.130 [28.70]	0.750 [19.05]	N/A
RJU095..1	4	7.690 [195.33]	1.130 [28.70]	N/A	0.812 [20.62]
RJU140	3	10.500 [266.70]	1.130 [28.70]	0.750 [19.05]	N/A
RJU140..1	4	11.690 [296.93]	1.130 [28.70]	N/A	0.812 [20.62]
RJU275	3	14.500 [368.30]	1.500 [38.10]	1.130 [28.70]	N/A
RJU275..1	4	15.690 [398.53]	1.500 [38.10]	N/A	1.140 [28.96]
RJU150	3	6.500 [165.10]	2.000 [50.80]	1.560 [39.62]	N/A
RJU150..1	4	7.690 [195.33]	2.000 [50.80]	N/A	1.140 [28.96]
RJU400	3	18.500 [469.90]	2.000 [50.80]	1.560 [39.62]	N/A
RJU400..1	4	19.690 [500.13]	2.000 [50.80]	N/A	1.140 [28.96]

Note:

 (1) Dimensional tolerances are ± 0.016 [0.406 mm] or $\pm 1\%$, whichever is greater.


Metal Oxide Resistors, High Power



FEATURES

- Rugged metal oxide film
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- High power dissipation in small size (1 W/0207 size to 4 W/0922 size)
- High temperature coating (up to 200 °C), non-flammable



STANDARD ELECTRICAL SPECIFICATIONS							
MODEL	SIZE	POWER RATING $P_{70\text{ }^\circ\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX. V_{\equiv}	TEMPERATURE COEFFICIENT ppm/K	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
WK2	0207	1.0	500	± 50	± 1	4R7 - 1M0	96
WK2	0207	1.0	500	± 100	± 2 ± 5	1R0 - 1M0 R18 - 10M	48 24
WK2	0207	1.0	500	± 200	± 5	0R18 - 10M	24
WR4	0414	2.0	500	± 200	± 2 ± 5	1R0 - 1M0 R18 - 10M	48 24
WR5	0617	3.0	750	± 200	± 2 ± 5	1R0 - 100K R22 - 560K	48 24
WK8	0922	4.0	750	± 200	± 2 ± 5	1R0 - 68K R22 - 100K	48 24

Notes:

- Coating: green
- Marking: WR4 has color code marking does not have a TCR band. WR5 and WK8 are printed marked. For further information see appropriate catalog or web page.

TECHNICAL SPECIFICATIONS					
PARAMETER	UNIT	WK2	WR4	WR5	WK8
Rated Dissipation at 70 °C	W	1.0	2.0	3.0	4.0
Limiting Element Voltage ⁽¹⁾	V_{\equiv}	500	500	750	750
Insulation Voltage (1 Min)	V_{eff}	> 500	> 500	> 500	> 500
Thermal Resistance (Max.)	K/W	≤ 140	≤ 100	≤ 70	≤ 60
Insulation Resistance	Ω	$> 10^9$			
Voltage Coefficient	1/V	$< 10^{-7}$			
Thermal Time Constant	s	14	20	35	70
Category Temperature Range ⁽²⁾	°C	- 55 to + 200			
Terminal Strength, Axial	N	> 60	> 80	> 80	> 80
Failure Rate	$10^{-8}/\text{h}$	< 1			
Weight	g	0.2	0.7	1.5	3.5

Notes:

⁽¹⁾ Rated Voltage $\sqrt{P \times R}$

⁽²⁾ For values < 10R the upper limiting temperature is 155 °C. The power rating is correspondingly lower and can be calculated by R_{th}



PART NUMBER AND PRODUCT DESCRIPTION WK2-SERIES

PART NUMBER: WK202070C1001FD5

W K 2 0 2 0 7 0 C 1 0 0 1 F D 5

MODEL/SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING (1)	SPECIAL
WK20207	0 = Neutral	C = ± 50 ppm/K B = ± 100 ppm/K A = ± 200 ppm/K	3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 2 = *10 ² 8 = *10 ⁻² 3 = *10 ³ 9 = *10 ⁻¹ 4 = *10 ⁴ 0 = *10 ⁰ 5 = *10 ⁵ 1 = *10 ¹ 6 = *10 ⁶	F = ± 1 % G = ± 2 % J = ± 5 %	22 = A2 25 = A5 D5 = R5	Up to 2 digits 00 = Standard
PRODUCT DESCRIPTION: WK2 50 1K0 1 % R5						
WK2	50	1K0	1 %	R5		
MODEL	TCR	RESISTANCE VALUE	TOLERANCE	PACKAGING (1)		
WK2	± 50 ppm/K ± 100 ppm/K ± 200 ppm/K	49K9 = 49.9 kΩ 50R1 = 50.1 Ω 1K0 = 1.0 kΩ	± 1 % ± 2 % ± 5 %	A2 A5 R5		

PART NUMBER AND PRODUCT DESCRIPTION WK8-SERIES

PART NUMBER: WK80922001000J5C

W K 8 0 9 2 2 0 0 1 0 0 0 J 5 C

MODEL/SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING (1)	SPECIAL
WK80922	0 = Neutral	0 = Standard	3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 2 = *10 ² 8 = *10 ⁻² 3 = *10 ³ 9 = *10 ⁻¹ 4 = *10 ⁴ 0 = *10 ⁰ 5 = *10 ⁵ 1 = *10 ¹	G = ± 2 % J = ± 5 %	5C = AC G1 = R1	Up to 2 digits 00 = Standard
PRODUCT DESCRIPTION: WK8 100R 5 % AC						
WK8	100R	5 %	AC			
MODEL	TCR	TOLERANCE	PACKAGING (1)			
WK8	100R = 100 Ω 47K = 47 kΩ	± 2 % ± 5 %	AC R1			

PART NUMBER AND PRODUCT DESCRIPTION WR-SERIES

PART NUMBER: WR404140A1001GFE

W R 4 0 4 1 4 0 A 1 0 0 1 G F E

MODEL/SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING (1)	SPECIAL
WR40414 WR50617	0 = Neutral	A = ± 200 ppm/K	3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 2 = *10 ² 8 = *10 ⁻² 3 = *10 ³ 9 = *10 ⁻¹ 4 = *10 ⁴ 0 = *10 ⁰ 5 = *10 ⁵ 1 = *10 ¹ 6 = *10 ⁶	G = ± 2 % J = ± 5 %	41 = A1 G73 51 = A1 G77 FE = RE G73 GP = RP	Up to 2 digits 00 = Standard
PRODUCT DESCRIPTION: WR4 1K0 2 % RE						
WR4	1K0	2 %	RE			
MODEL	RESISTANCE VALUE	TOLERANCE	PACKAGING (1)			
WR4 WR5	1K0 = 1.0 kΩ 51R0 = 51.0 Ω	± 2 % ± 5 %	A1 (G73) A1 (G77) RE (G73) RP			

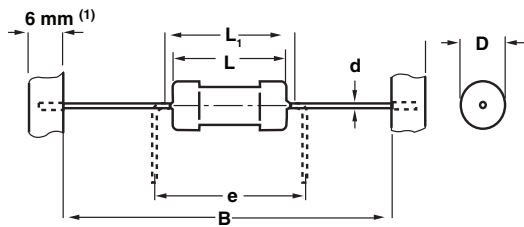
Notes:

(1) Please refer to table PACKAGING

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products

PACKAGING						
MODEL	REEL			BOX		
	PIECES/REEL	CODE	MIN. ORDER QTY PACKAGING UNITS	PIECES/BOX	CODE	MIN. ORDER QTY PACKAGING UNITS
WK2	5000	R5	1	5000 2000	A5 A2	1 1
WR4	2500	RE	2	1000	A1	2
WR5	1500	RP	2	1000	A1	2
WK8	1000	R1	2	500	AC	2

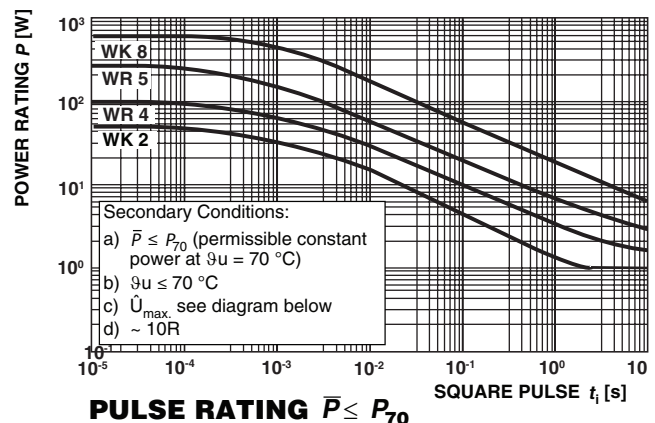
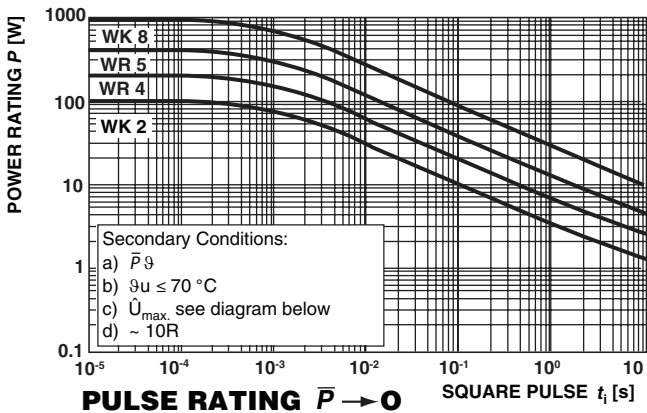
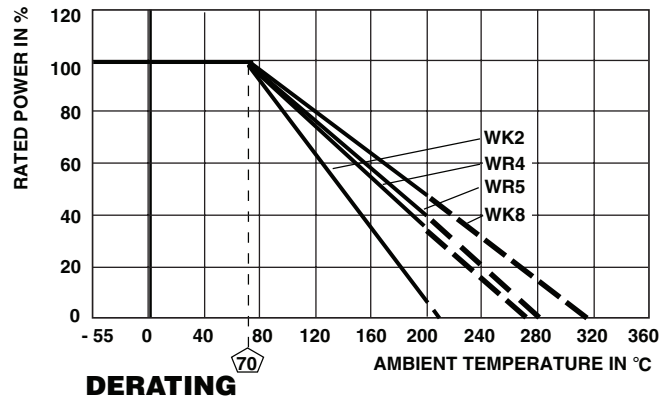
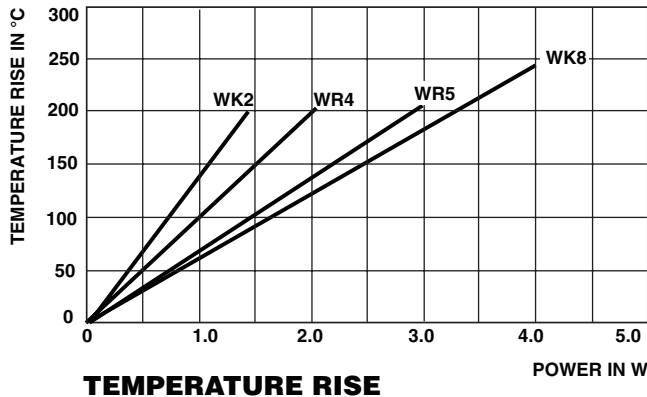
DIMENSIONS

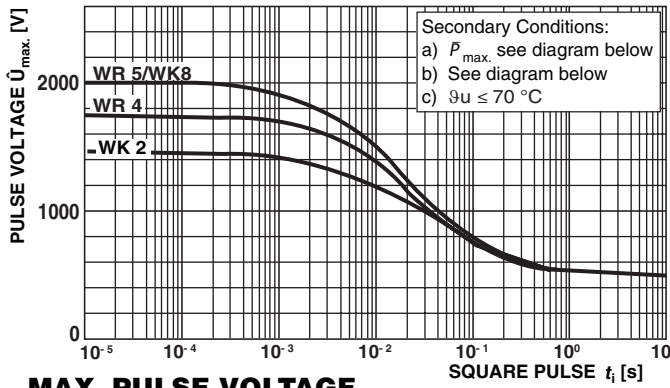


MODEL	DIMENSIONS [in millimeters]					
	D	L	L ₁ max.	B	d	e
WK2	2.5 - 0.5	6.3 - 0.5	8.0	53 ± 1	0.6	7.5
WR4	4.1 - 0.5	12.0 - 1.5	16.0	73 ± 1	0.8	15.0
WR5	6.0 - 0.5	16.5 - 1.5	20.0	77 ± 1	0.8	17.5
WK8	9.0 - 0.5	20.0 - 1.5	24.0	77 ± 1	0.8	22.5

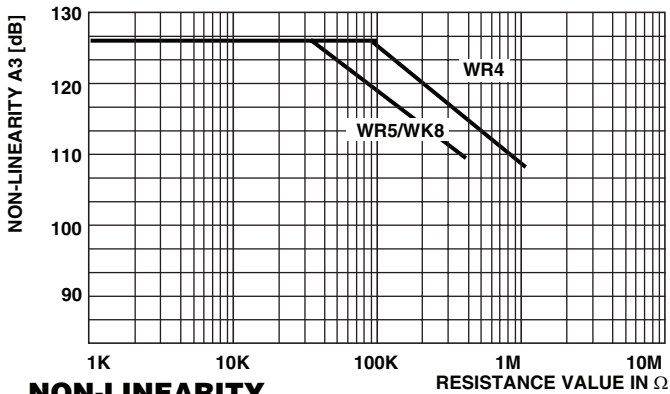
Notes:

- (1) 9 mm for WR5/WK8
- Taping in acc. with IEC60286-1
- D and L measured in acc. with IEC60294
- d according to IEC60301

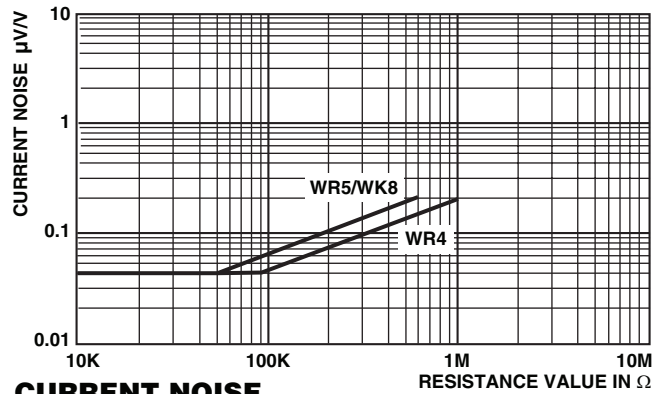




MAX. PULSE VOLTAGE



NON-LINEARITY



CURRENT NOISE

PERFORMANCE		
TEST	CONDITIONS OF TEST	REQUIREMENTS ⁽¹⁾
Rated Dissipation at 70 °C IEC 60115-1 4.25.1	1000 h at 70 °C 1.5 h ON, 0.5 h OFF	WK2 = ± 1.5 % WK4/8 = ± 2.0 % WR4/5 = ± 5.0 %
Endurance at UCT IEC 60115-1 4.25.3	1000 h at 155 °C without load	≤ ± 1 %
Overload Test IEC 60115-1 4.13	Short time overload 5 s at 2.5 x rated voltage or ± twice the limiting element voltage	≤ ± 0.25 %
Thermal Shock IEC 60115-1 4.19, IEC 60068-2-14	Rapid change between upper and lower category temperature	≤ ± 0.25 %
Climatic Sequence IEC 60115-1 4.23	Dry heat, damp heat cycle, cold, low air pressure	≤ ± 0.5 %
Damp Heat Steady State IEC 60115-1 4.24, IEC 60068-2-3	56 days at 40 °C and 93 % relative humidity	≤ ± 1.5 %
Resistance to Soldering Heat IEC 60115-1 4.18, IEC 60068-2-20	10 s at 260 °C solder bath temperature	≤ ± 0.25 %
Robustness of Terminations IEC 60115-1 4.16	Tensile, bending and torsion	≤ ± 0.25 %
Vibration IEC 60115-1 4.22	0.75 mm or 10 g, 10 Hz - 500 Hz 6 h	≤ ± 0.25 %

Note:

⁽¹⁾ Limiting for change of resistance at test

APPLICABLE SPECIFICATIONS
<ul style="list-style-type: none"> • CECC 40000 • EN 140000 IEC 60115-1

Metal Oxide Resistors, Special Purpose, High Voltage



FEATURES

- Low TC: ± 200 ppm/ $^{\circ}\text{C}$ standard; ± 100 ppm/ $^{\circ}\text{C}$, ± 50 ppm/ $^{\circ}\text{C}$ available
- $\pm 1\%$ standard to $1\text{ G}\Omega$; $\pm 5\%$ above $1\text{ G}\Omega$
 $\pm 0.5\%$ available in ± 50 ppm/ $^{\circ}\text{C}$ only. Special tolerance and/or temperature coefficient matching available.
- High Voltage type (up to 8 kV)
- For oil bath or open air operation
- Matched sets available
- Special testing available upon request
- Lead (Pb)-free version is RoHS compliant



RoHS*
COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS

GLOBAL MODEL	HISTORICAL MODEL	POWER RATING			VOLTAGE RATING V_{\equiv}	RESISTANCE RANGE Ω ⁽²⁾			
		$P_{25^{\circ}\text{C}}$ W ⁽¹⁾	$P_{70^{\circ}\text{C}}$ W ⁽¹⁾	$P_{125^{\circ}\text{C}}$ W ⁽¹⁾		200 ppm	100 ppm	50 ppm	NON-INDUCTIVE ⁽³⁾
RNX025	RNX-1/4	0.5	0.36	0.25	750 V	1K - 100M	1K - 100M	1M - 22M	100R - 100K
RNX038	RNX-3/8	1.0	0.72	0.5	1.5 kV	1K - 1G	1K - 100M	1M - 50M	100R - 100K
RNX050	RNX-1/2	1.2	0.86	0.6	2 kV	1K - 2G	1K - 250M	1M - 100M	100R - 100K
RNX075	RNX-3/4	2.0	1.44	1.0	3 kV	1K - 2G	1K - 500M	1M - 100M	100R - 100K
RNX100	RNX-1	2.5	1.8	1.25	4 kV	1K - 2G	1K - 500M	1M - 100M	100R - 1M
RNX125	RNX-1-1/4	3.0	2.16	1.5	5 kV	1K - 2G	1K - 500M	-	100R - 1M
RNX150	RNX-1-1/2	4.0	2.88	2.0	6 kV	1K - 2G	1K - 500M	-	100R - 1M
RNX200	RNX-2	5.0	3.6	2.5	8 kV	1K - 2G	1K - 500M	-	100R - 1M

Notes:

- ⁽¹⁾ Increase wattage by 25 % for 0.032" [0.813 mm] diameter leads
- ⁽²⁾ For resistance values above and below those listed please contact us
- ⁽³⁾ Non inductive ± 200 ppm/ $^{\circ}\text{C}$ TCR only
- **All resistance values are calibrated at 100 VDC. Calibration at other voltages available**
- Part Marking: print marked - DALE, model, value, tolerance, TCR, date code (model and date omitted on RNX-1/4)
- Special Modifications:
 - Special preconditioning (power aging, temperature cycling etc.) to customer specifications
 - Non-helixed resistors can be supplied for critical high frequency applications (non-inductive)

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: RNX05010K0KKLB (preferred part numbering format)

R N X 0 5 0 1 0 K 0 K K L B

GLOBAL MODEL (see Standard Electrical Specifications table)	RESISTANCE VALUE R = Decimal K = Thousand M = Million G = Billion 910R = 910 Ω 10M0 = 10 M Ω 1G00 = 1.0 G Ω	TOLERANCE CODE D = $\pm 0.5\%$ F = $\pm 1\%$ G = $\pm 2\%$ J = $\pm 5\%$ K = $\pm 10\%$	TEMP. COEFFICIENT H = 50 ppm K = 100 ppm N = 200 ppm	PACKAGING ⁽⁴⁾ EL = Lead (Pb)-free, Lacer EB = Lead (Pb)-free, T/R (1000 pcs) EE = Lead (Pb)-free, T/R (1000 pcs) LB = Tin/Lead, Lacer R6 = Tin/Lead, T/R (1000 pcs) RC = Tin/Lead, T/R (1000 pcs) RF = Tin/Lead, T/R (1000 pcs)	CONSTRUCTION Blank = Standard N = Non-inductive P = 0.032" \varnothing leads	SPECIAL Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable
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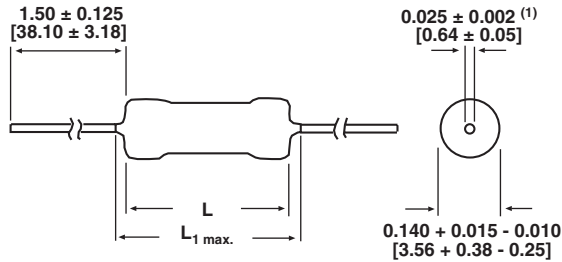
Historical Part Number example: RNX-1/210K0KK (will continue to be accepted)



Notes:

- ⁽⁴⁾ Some packaging codes are model specific
- * Pb containing terminations are not RoHS compliant, exemptions may apply.

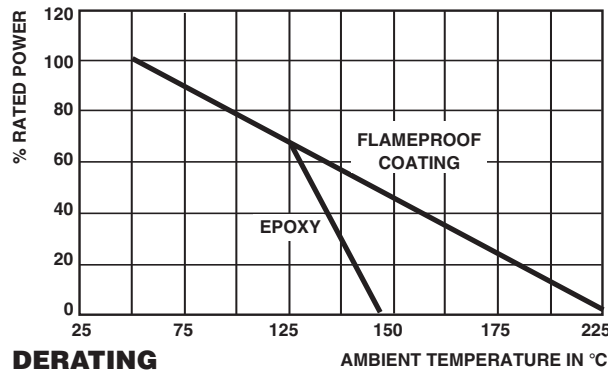
DIMENSIONS



GLOBAL MODEL	DIMENSIONS in inches [millimeters]	
	L	L ₁ max.
RNX025	0.290 ± 0.020 [7.37 ± 0.51]	0.358 [9.09]
RNX038	0.420 ± 0.020 [10.67 ± 0.51]	0.470 [11.94]
RNX050	0.540 ± 0.020 [13.72 ± 0.51]	0.595 [15.11]
RNX075	0.790 ± 0.020 [20.07 ± 0.51]	0.845 [21.46]
RNX100	1.040 ± 0.020 [26.42 ± 0.51]	1.100 [27.81]
RNX125	1.290 ± 0.020 [32.77 ± 0.51]	1.350 [34.16]
RNX150	1.540 ± 0.020 [39.12 ± 0.51]	1.600 [40.51]
RNX200	2.040 ± 0.020 [51.82 ± 0.51]	2.100 [53.34]

Note:
(1) Available with 0.032" [0.813 mm] leads ± 0.002" [0.051 mm].

TECHNICAL SPECIFICATIONS									
PARAMETER	UNIT	RNX025	RNX038	RNX050	RNX075	RNX100	RNX125	RNX150	RNX200
Insulation Resistance	Ω	≥ 10 ¹¹							
Category Temperature Range	°C	- 55/+ 155							



MATERIAL SPECIFICATIONS	
Element:	High temperature fired cermet film
Core:	High purity 96 % alumina
Coating:	Epoxy on RNX025 and RNX038 Flameproof on RNX050 to RNX200
Termination:	Standard lead material is solder - coated copper. Solderable and weldable.

MECHANICAL SPECIFICATIONS	
Terminal Strength:	5 pound pull test
Solderability:	Continuous satisfactory coverage when tested in accordance with MIL-STD-202, Method 208

Metal Oxide Resistors, Special Purpose, High Voltage



FEATURES

- Low TCR: ± 200 ppm/ $^{\circ}\text{C}$ standard; ± 100 ppm/ $^{\circ}\text{C}$, ± 50 ppm/ $^{\circ}\text{C}$ available
- Tolerances: $\pm 1\%$, $\pm 2\%$, $\pm 5\%$, $\pm 10\%$
- High Voltage (up to 45 kV)
- For oil bath or open air operation
- Matched sets available
- Special testing available upon request
- Lead (Pb)-free version is RoHS compliant



STANDARD ELECTRICAL SPECIFICATIONS									
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING			VOLTAGE RATING V _≡	RESISTANCE RANGE Ω ⁽²⁾			
		P _{25 °C} W ⁽¹⁾	P _{70 °C} W ⁽¹⁾	P _{125 °C} W ⁽¹⁾		200 ppm	100 ppm	50 ppm	NON-INDUCTIVE ⁽³⁾
ROX050	ROX-1/2	2.0	1.4	1.0	2 kV	1K - 1G	1K - 100M	1M - 100M	-
ROX075	ROX-3/4	3.0	2.16	1.5	5 kV	1K - 3G	1K - 500M	1M - 100M	100R - 1M
ROX100	ROX-1	4.0	2.88	2.0	7.5 kV	1K - 3G	1K - 500M	1M - 100M	100R - 1M
ROX150	ROX-1-1/2	5.0	3.6	2.5	11 kV	1K - 3G	1K - 500M	1M - 100M	100R - 1M
ROX200	ROX-2	6.0	4.32	3.0	15 kV	1K - 3G	1K - 1G	1M - 500M	100R - 1M
ROX300	ROX-3	10.0	7.2	5.0	22.5 kV	1K - 3G	1K - 1G	1M - 500M	400R - 10M
ROX400	ROX-4	12.0	8.64	6.0	30 kV	1K - 3G	1K - 1G	1M - 500M	500R - 10M
ROX500	ROX-5	16.0	11.52	8.0	37.5 kV	1K - 3G	1K - 1G	1M - 500M	500R - 10M
ROX600	ROX-6	20.0	14.4	10.0	45 kV	1K - 3G	1K - 1G	1M - 500M	500R - 10M

Note:

- ⁽¹⁾ Increase wattage by 40 % for 0.040" [1.02 mm] diameter leads
- ⁽²⁾ For resistance values above and below those listed please contact us
- ⁽³⁾ Non inductive ± 200 ppm/ $^{\circ}\text{C}$ TCR only
- All resistance values are calibrated at 100 VDC. Calibration at other voltages available
- $\pm 1\%$ not available above 1 G Ω
- Part Marking: print marked - DALE, model, value, tolerance, temperature coefficient, date code

TECHNICAL SPECIFICATIONS										
PARAMETER	UNIT	ROX050	ROX075	ROX100	ROX150	ROX200	ROX300	ROX400	ROX500	ROX600
Insulation Resistance	Ω	$\geq 10^{11}$								
Category Temperature Range	$^{\circ}\text{C}$	- 55/+ 155								

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: ROX300100MGNF5 (preferred part numbering format)

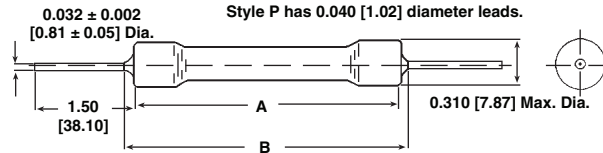
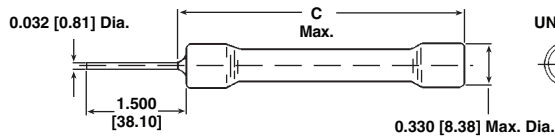
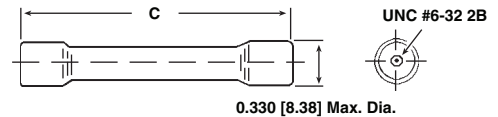
R	O	X	3	0	0	1	0	0	M	G	N	F	5					
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GLOBAL MODEL (see Electrical Specifications table)	RESISTANCE VALUE	TOLERANCE CODE	TEMP COEFFICIENT	PACKAGING ⁽⁴⁾	CONSTRUCTION	SPECIAL
	R = Decimal K = Thousand M = Million G = Billion 910R = 910 Ω 10M0 = 10 M Ω 1G00 = 1.0 G Ω	F = $\pm 1\%$ G = $\pm 2\%$ J = $\pm 5\%$ K = $\pm 10\%$	H = 50 ppm K = 100 ppm N = 200 ppm	EL = Lead (Pb)-free, Lacer EE = Lead (Pb)-free, T/R (1000 pieces) EM = Lead (Pb)-free, Foam LB = Tin/Lead, Lacer RF = Tin/Lead, T/R (1000 pieces) F5 = Tin/Lead, Foam	(up to 2 digits) Blank = Standard N = Non-inductive P = 0.040 \varnothing leads S = Solid Body, Axial T = Threaded Terminals Y = One end Axial, one Threaded Terminal	Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable

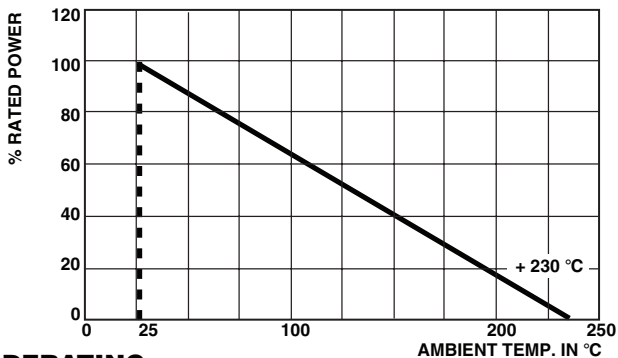
Historical Part Number example: ROX-3100MGN (will continue to be accepted)

ROX-3		100M	G	N	F05
HISTORICAL MODEL	CONSTRUCTION	RESISTANCE VALUE	TOLERANCE CODE	TEMP. COEFFICIENT	PACKAGING

Note:
⁽⁴⁾ Some packaging codes are model specific.
 * Pb containing terminations are not RoHS compliant, exemptions may apply

DIMENSIONS
Styles N, P and S

Style Y

Style T


DIMENSIONS in inches [millimeters]				
GLOBAL MODEL	STYLE N, P, S		STYLE T	STYLE Y
	A	B	C	C MAX.
ROX050	0.550 ± 0.032 [13.97 ± 0.81]	0.700 [17.78]	N/A	N/A
ROX075	0.800 ± 0.032 [20.32 ± 0.81]	0.900 [22.86]	1.168 ± 0.022 [29.72 ± 0.56]	1.050 [26.67]
ROX100	0.920 ± 0.032 [23.37 ± 0.81]	1.020 [25.91]	1.288 ± 0.022 [32.77 ± 0.56]	1.170 [29.72]
ROX150	1.550 ± 0.032 [39.37 ± 0.81]	1.650 [41.91]	1.918 ± 0.022 [48.77 ± 0.56]	1.800 [45.72]
ROX200	2.050 ± 0.032 [52.07 ± 0.81]	2.150 [54.61]	2.418 ± 0.022 [61.47 ± 0.56]	2.300 [58.42]
ROX300	3.050 ± 0.032 [77.47 ± 0.81]	3.150 [80.01]	3.418 ± 0.022 [86.87 ± 0.56]	3.300 [83.82]
ROX400	4.050 ± 0.032 [102.87 ± 0.81]	4.150 [105.41]	4.418 ± 0.022 [112.27 ± 0.56]	4.300 [109.22]
ROX500	5.050 ± 0.032 [128.27 ± 0.81]	5.150 [130.81]	5.418 ± 0.022 [137.67 ± 0.56]	5.300 [134.62]
ROX600	6.050 ± 0.032 [153.67 ± 0.81]	6.150 [156.21]	6.418 ± 0.022 [163.07 ± 0.56]	6.300 [160.02]


DERATING
MECHANICAL SPECIFICATIONS
Terminal Strength:

10 pound pull test

Solderability:

Continuous satisfactory coverage when tested in accordance with MIL-STD-202, Method 208

MATERIAL SPECIFICATIONS

Element	High temperature fired cermet film
Core	High purity 96 % alumina, tubular or solid
Coating	Blue flameproof on ROX050 thru ROX200. Black silicone on ROX300 thru ROX600
Termination	Standard lead material is solder - coated copper; solderable and weldable. 0.032" [0.813 mm] Style P 0.040" [1.02 mm] available

Metal Oxide Resistors, Special Purpose, High Voltage, Ratio Divider



FEATURES

- Higher ranges and different sizes available on request
- ± 200 ppm/ $^{\circ}\text{C}$ standard, ± 100 ppm/ $^{\circ}\text{C}$ available
- Tolerance ratio $\pm 1\%$
- Available with leads and/or mounting lugs in any required combination

STANDARD ELECTRICAL SPECIFICATIONS						
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{125^{\circ}\text{C}}$ W	VOLTAGE R_1	RESISTANCE RANGE Ω		MAXIMUM RATIO
				Min. R1	Max. R2	
RDX2	RDX-2	4.0	15.0 kV	2K	2G	5000:1
RDX3	RDX-3	5.0	22.5 kV	3K	10G	10 000:1
RDX4	RDX-4	7.0	30.0 kV	4K	10G	10 000:1
RDX5	RDX-5	8.0	37.5 kV	5K	10G	10 000:1
RDX6	RDX-6	10.0	45.0 kV	6K	10G	10 000:1
RDX7	RDX-7	12.0	52.5 kV	7K	10G	10 000:1

GLOBAL PART NUMBER INFORMATION							
New Global Part Numbering: RDX3A2M50G10000:1M (preferred part numbering format)							
<div style="display: flex; justify-content: space-around; font-weight: bold; font-size: 1.2em;"> R D X 3 A 2 M 5 0 G N J 0 3 A A </div>							
GLOBAL MODEL	CONSTRUCTION	RESISTANCE VALUE (R1)	TOLERANCE CODE	TEMP. COEFFICIENT	PACKAGING	RATIO	SPECIAL
RDX2 RDX3 RDX4 RDX5 RDX6 RDX7	A = Axial Leads B = Radial Tabs C = Radial Ends, Axial Tap	K = Thousand M = Million G = Billion 2K00 = 2.0 k Ω 100M = 100 M Ω 10G0 = 10 G Ω	F = $\pm 1\%$ G = $\pm 2\%$ J = $\pm 5\%$ K = $\pm 10\%$	K = 100 ppm N = 200 ppm	E03 = Lead (Pb)-free, Skin J03 = Tin/Lead, Skin	AA = 10 000:1 AB = 5 000:1 AC = 1000:1 ZZ = Custom	Blank = Standard (Dash Number) (up to 2 digits) From 1 - 99 as applicable
Historical Part Number: RDX-3A2M50G10000:1M (will continue to be accepted)							
<div style="display: flex; justify-content: space-around; font-weight: bold; font-size: 1.2em;"> RDX-3 A 2M50 G 10 000:1 M J03 </div>							
HISTORICAL MODEL	CONSTRUCTION	RESISTANCE VALUE	TOLERANCE CODE	RATIO	TEMP. COEFFICIENT	PACKAGING	



Metal Oxide Resistors,
Special Purpose, High Voltage, Ratio Divider

DIMENSIONS in inches [millimeters]

GLOBAL MODEL	ELEMENT CONFIGURATION ⁽¹⁾	LENGTH MAXIMUM	DIAMETER MAXIMUM
RDX2	ROX100, ROX100	2.620 [66.55]	0.325 [8.26]
RDX3	ROX200, ROX100	3.570 [90.70]	0.325 [8.26]
RDX4	ROX300, ROX100	4.570 [116.10]	0.325 [8.26]
RDX5	ROX400, ROX100	5.570 [141.50]	0.325 [8.26]
RDX6	ROX500, ROX100	6.570 [166.90]	0.325 [8.26]
RDX7	ROX600, ROX100	7.570 [192.30]	0.325 [8.26]

Note:

⁽¹⁾ See ROX for dimensions

MARKING

- DALE
- Model
- Value
- Ratio
- Date code





Metal Glaze Resistors

High Ohmic Values
•
High Voltage Strength



Contents

HVW/MVW	188
LSR37	190
VR25	196
VR37	202
VR68	208
SVR52.....	214

Metal Alloy Resistors, Special Purpose, High Voltage



FEATURES

- HVW and MVW are uncoated. HVX (blue flameproof coating) available on request.
- High voltage (up to 15 kV)
- Semi-precision: $\pm 5\%$, $\pm 10\%$, $\pm 20\%$
- Axial leads: HVW = Tinned copper
MVW = Copper clad steel
- Lead (Pb)-free version is RoHS compliant



RoHS*
COMPLIANT

MATERIAL SPECIFICATIONS

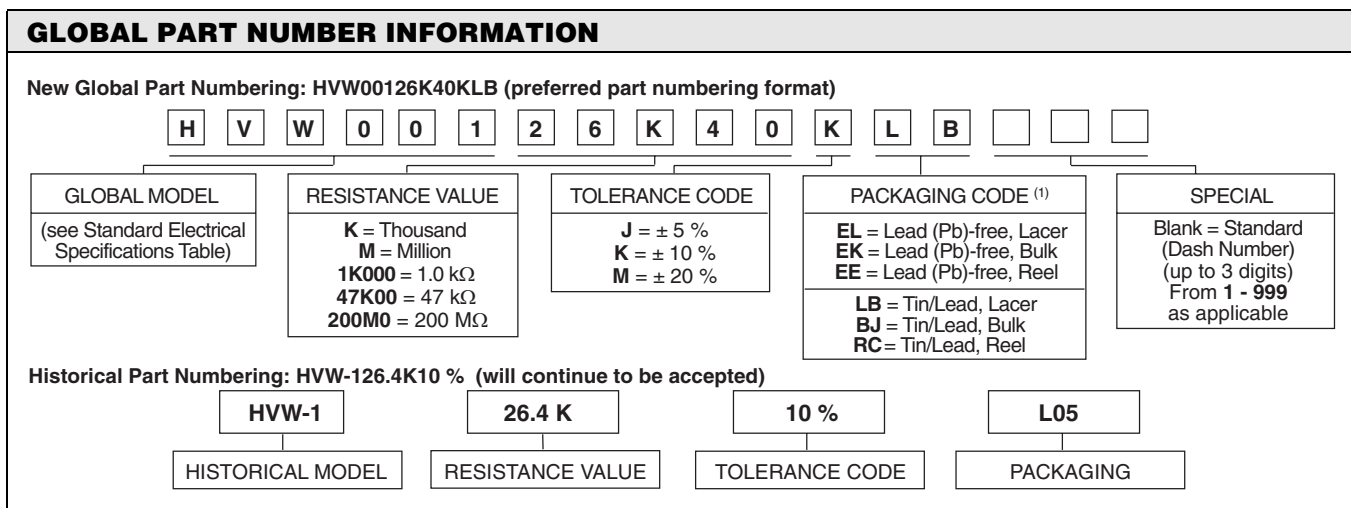
Element: Metal alloy

Core: Alkaline earth porcelain

STANDARD ELECTRICAL SPECIFICATIONS				
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{70^\circ\text{C}}$ W	VOLTAGE RATING	RESISTANCE RANGE Ω
HVW1/2	HVW-1/2	1.0	3.5 kV	1K0 - 25M
MVW1/2	MVW-1/2	1.0	3.5 kV	1K0 - 25M
HVW3/4	HVW-3/4	1.5	7.5 kV	1K0 - 50M
MVW3/4	MVW-3/4	1.5	7.5 kV	1K0 - 50M
HVW001	HVW-1	2.5	7.5 kV	1K0 - 75M
HVW002	HVW-2	5.0	15.0 kV	1K0 - 200M

Note:

All resistance values are calibrated at 100 VDC. Calibration at other voltages upon request.



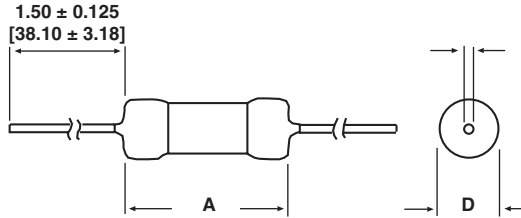
Note:

⁽¹⁾ MVW products do not contain lead. Use tin/lead packaging codes to specify these lead free MVW products. Use lead free packaging codes to specify lead free HVW and HVX products.

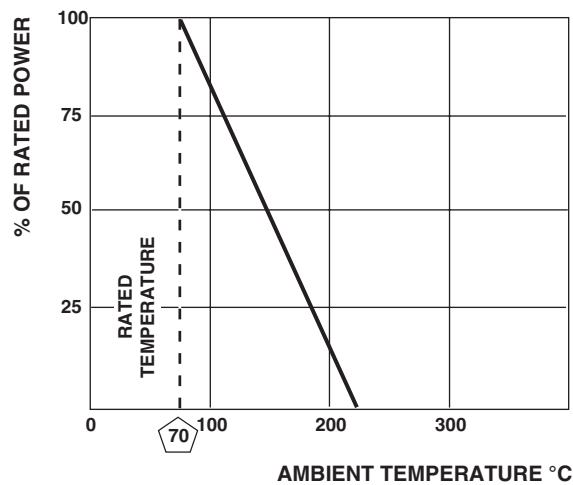
* Pb containing terminations are not RoHS compliant, exemptions may apply

DIMENSIONS in inches [millimeters]

HVW/MVW
(Uncoated)



GLOBAL MODEL	A	C	D (Max.)
HVW1/2	0.545 ± 0.0015 [13.84 ± 0.38]	0.032 ± 0.002 [0.81 ± 0.05]	0.155 [3.94]
MVW1/2	0.545 ± 0.0015 [13.84 ± 0.38]	0.032 ± 0.002 [0.81 ± 0.05]	0.155 [3.94]
HVW3/4	0.895 ± 0.010 [22.73 ± 0.25]	0.032 ± 0.002 [0.81 ± 0.05]	0.155 [3.94]
MVW3/4	0.895 ± 0.010 [22.73 ± 0.25]	0.032 ± 0.002 [0.81 ± 0.05]	0.155 [3.94]
HVW001	0.920 ± 0.020 [23.37 ± 0.51]	0.032 ± 0.002 [0.81 ± 0.05]	0.275 [6.99]
HVW002	2.080 ± 0.030 [52.38 ± 0.76]	0.032 ± 0.002 [0.81 ± 0.05]	0.275 [6.99]

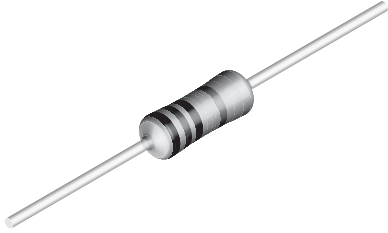


DERATING

Note:

For operation in oil or inert atmosphere derating, consult factory.

High Voltage Surge Resistor




A metal glazed film is deposited on a high grade ceramic body. After that caps are applied to the rods and tinned electrolytic copper wires are welded to these end caps.

The resistors are coated with a light-blue lacquer which provides electrical, mechanical and climatic protection.

The encapsulation is resistant to all cleaning solvents according to "MIL-STD 202E, method 215" and "IEC 60068-2-45".

FEATURES

- High pulse-loading (10 kV as specified) capability (flashes) 
- Good replacement for carbon-composite resistors
- Lead (Pb)-free solder contacts
- Pure Tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)

APPLICATIONS

- Application in overload and high voltage pulse hazard circuits (TV-sets, monitors), high power electronic ballasts

TECHNICAL SPECIFICATIONS	
DESCRIPTION	VALUE
Resistance Range	47 Ω to 820 Ω 1 kΩ to 10 kΩ
Resistance Tolerance and Series	47 Ω to 180 Ω: ± 20 %; E12 series 220 Ω to 10 kΩ: ± 10 %; ± 20 %; E12 series
Maximum Dissipation at $T_{amb} = 70\text{ °C}$	0.5 W
Thermal Resistance, R_{th}	120 K/W
Temperature Coefficient	47 Ω to 180 Ω: 0 to + 1500 x 10 ⁻⁶ /K 220 Ω to 910 Ω: 0 to + 600 x 10 ⁻⁶ /K - 600 to + 200 x 10 ⁻⁶ /K
Voltage Coefficient	0 to + 350 x 10 ⁻⁶ /V ± 50 x 10 ⁻⁶ /V
Maximum Permissible Voltage	$V = \sqrt{Pn \times R}$
Dielectric Withstanding Voltage of the Insulation for 1 Min	700 V
Basic Specifications	IEC 60115-1B -
Climatic Category (IEC 60068)	55/155/56
Stability After:	
Load (1000 h)	ΔR max.: ± (3.0 % R + 0.10 Ω)
Climatic Test	ΔR max.: ± (3.0 % R + 0.10 Ω)
Soldering	ΔR max.: ± (1.0 % R + 0.10 Ω)
High Voltage Test for R-Value > 3.3 kΩ, 10 kV; 1 nF; 50 x 12/Min	$\Delta R/R$ max.: ± 20 % (typical value ± 10 %)
ESD Contact Discharge 12 kV; 100 Pulses	$\Delta R/R$ max.: ± 20 % (typical value: ± 10 %)

12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 2322 245
- The subsequent 2 digits indicate the resistor type and packing
- The remaining digits indicate the resistance value:
 - The first 2 digits indicate the resistance value
 - The last digit indicates the resistance decade

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
47 to 82 Ω	9
100 to 820 Ω	1
1 to 9.1 kΩ	2
10 kΩ	3

12NC Example

The 12NC for a LSR37, resistor value 1.5 kΩ, 10 % tolerance, supplied on a bandolier of 1000 units in ammpack, is: 2322 245 12152.



12NC - resistor type and packaging			
TYPE	TOLERANCE (%)	ORDERING CODE 2322 245	
		1000 UNITS IN AMMOPACK	5000 UNITS ON REEL
LSR37	± 10	12...	22...
	± 20	11...	21...

PART NUMBER

PART NUMBER: LSR3700001002KA100

L	S	R	3	7	0	0	0	0	1	0	0	2	K	A	1	0	0
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MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING ⁽¹⁾	SPECIAL
LSR3700	0 = Neutral Z = Value overflow (Special)	0 = Standard	3 digit value 1 digit multiplier 9 = *10 ⁻¹ 0 = *10 ⁰ 1 = *10 ¹ 2 = *10 ²	K = ± 10 % M = ± 20 %	A1 R5	The 2 digits are used for all special parts. 00 = Standard

PRODUCT DESCRIPTION: LSR37 10 % A1 10K

LSR37	10 %	A1	10K
MODEL/SIZE	TOLERANCE	PACKAGING ⁽¹⁾	RESISTANCE VALUE
LSR37	± 10 % ± 20 %	A1 R5	220R = 220 Ω 1K2 = 1.2 kΩ

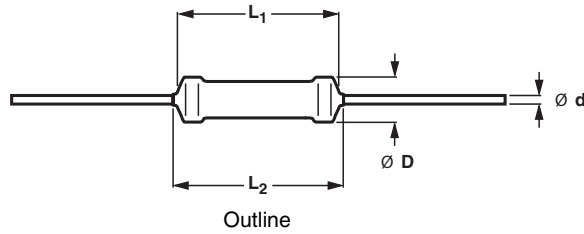
Notes:

⁽¹⁾ Please refer to table PACKAGING

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

PACKAGING			
CODE	PIECES	DESCRIPTION	MODEL/SIZE
A1	1000	Bandolier in ammpack straight leads	LSR37
R5	5000	Bandolier on reel straight leads	

DIMENSIONS



DIMENSIONS - resistor type and relevant physical dimensions				
TYPE	Ø D _{max.}	L ₁ max.	L ₂ max.	Ø d
LSR37	4.0	9.0	10.0	0.7 ± 0.03

MASS PER 100 UNITS	
TYPE	MASS (g)
LSR37	45.7

Three bands are used for 20 % tolerance with no indication for the tolerance. Four bands are used for 10 % tolerance.

Grey is used instead of silver for 10 % because metal particles in the lacquer could affect high-voltage properties.

MARKING

The nominal resistance and tolerance are marked on the resistor using colored bands in accordance with IEC publication 60062 “Color codes for fixed resistors”.

OUTLINES

The length of the body (L₁) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation (“IEC publication 60294”).

FUNCTIONAL PERFORMANCE

PRODUCT CHARACTERIZATION

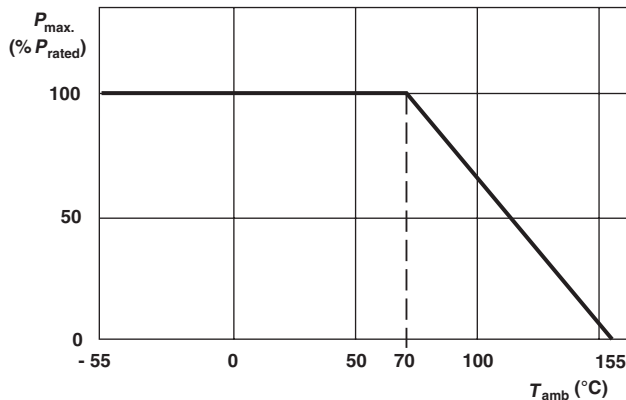
Standard values of rated resistance (nominal resistance) are taken from the E12 series with a tolerance of 10 % or 20 %. The values of the E12 series are in accordance with “IEC publication 60063”.

The limiting voltage DC is not applicable, because the maximum rated voltage for the maximum R_n-value of 10 kΩ at P_n = 0.5 W is only 70.7 V.

LIMITING VALUES		
TYPE	LIMITING VOLTAGE ⁽¹⁾ (V)	LIMITING POWER (W)
LSR37	$V = \sqrt{P_n \times R}$	0.5

Notes:

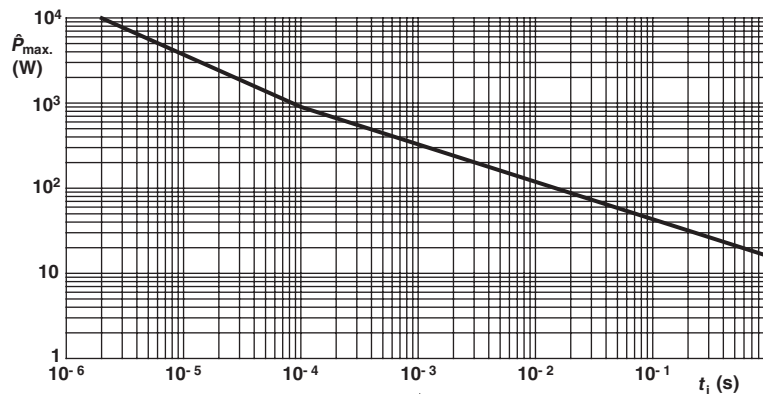
- ⁽¹⁾ The maximum voltage that may be continuously applied to the resistor element, see “IEC publication 60115-1”
- The maximum permissible hot-spot temperature is 155 °C



The power that the resistor can dissipate depends on the operating temperature

Maximum dissipation ($P_{max.}$) in percentage of rated power as a function of the ambient temperature (T_{amb}).

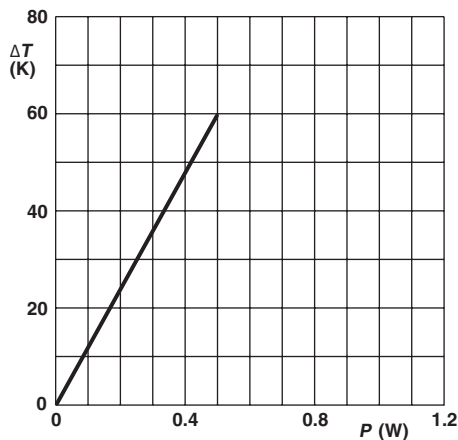
Derating



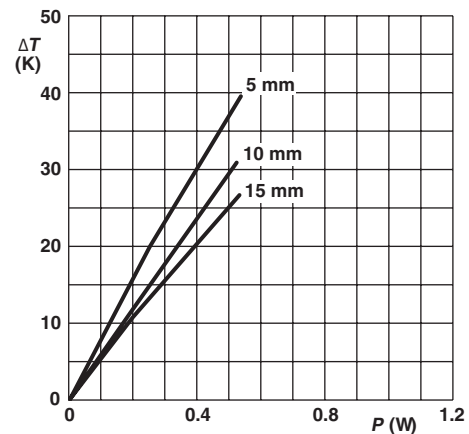
Pulse on a regular basis; maximum permissible peak pulse power $\hat{P}_{max.}$ as a function of pulse duration (t_i) for single pulse condition

Pulse Loading Capability

The resistors with straight leads are suitable for processing on automatic insertion equipment and cutting and bending machines. the minimum pitch for this type is 6e (15 mm). For temperature rise at soldering place see figures below.



Hot-spot temperature rise (ΔT) as a function of dissipated power



Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting

Application Information



TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of “IEC publication 60115-1”, category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 60068-2, “Recommended basic climatic and mechanical robustness testing procedure for electronic components” and

under standard atmospheric conditions according to “IEC 60068-1”, subclause 5.3.

In the Test Procedures and Requirements table the tests and requirements are listed with reference to the relevant clauses of “IEC publications 60115-1 and 60068-2”; a short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying.

All soldering tests are performed with mildly activated flux.

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.16	21 (U)	robustness of terminations:		
4.16.2	21 (Ua1)	tensile all samples	Ø 0.7 mm; load 10 N; 10 s	number of failures < 10 x 10 ⁻⁶
4.16.3	21 (Ub)	bending half number of samples	Ø 0.7 mm; load 5 N; 4 x 90°	number of failures < 10 x 10 ⁻⁶
4.16.4	21 (Uc)	torsion other half of samples	3 x 360° in opposite directions	no damage ΔR max.: ± (1.0 % R + 0.10 Ω)
4.17	20 (Ta)	solderability	2 s; 235 °C	good tinning; no damage
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 3 mm from body	ΔR max.: ± (1.0 % R + 0.10 Ω)
4.19	14 (Na)	rapid change of temperature	30 min at - 55 °C and 30 min at + 155 °C; 5 cycles	ΔR max.: ± (1.0 % R + 0.10 Ω)
4.20	29 (Eb)	bump	3 x 1500 bumps in 3 directions; 40 g	no damage ΔR max.: ± (1.0 % R + 0.10 Ω)
4.22	6 (Fc)	vibration	frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 h (3 x 2 h)	no damage ΔR max.: ± (1.0 % R + 0.10 Ω)

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	16 h; 155 °C	$R_{ins} \text{ min.: } 10^3 \text{ M}\Omega$ $\Delta R \text{ max.: } \pm (3.0 \% R + 0.10 \Omega)$
4.23.3	30 (Db)	damp heat (accelerated) 1st cycle	24 h; 55 °C; 90 to 100 % RH	
4.23.4	1 (Aa)	cold	2 h; - 55 °C	
4.23.5	13 (M)	low air pressure	2 h; 8.5 kPa; 15 to 35 °C	
4.23.6	30 (Db)	damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 to 100 % RH	
4.24.2	3 (Ca)	damp heat (steady state)	56 days; 40 °C; 90 to 95 % RH; dissipation 0.01 P _n ; limiting voltage 100 V (DC)	
4.25.1		endurance	1000 h at 70 °C; P _n or V _{max.}	$\Delta R \text{ max.: } \pm (3.0 \% R + 0.10 \Omega)$
4.8.4		temperature coefficient	47 Ω to 180 Ω	0 to + 1500 x 10 ⁻⁶ /K
			220 Ω to 910 Ω	0 to + 600 x 10 ⁻⁶ /K
			1 kΩ to 10 kΩ	- 600 to + 200 x 10 ⁻⁶ /K
4.7		voltage proof on insulation	700 V _{RMS} during 1 min; V-block method	no breakdown
4.6.1.1		insulation resistance	500 V (DC) during 1 min; V-block method	$R_{ins} \text{ min.: } 10^4 \text{ M}\Omega$
4.13		short time overload	room temperature; dissipation 6.25 x P _n ; 10 cycles; 5 s ON and 45 s OFF	$\Delta R \text{ max.: } \pm (2.5 \% R + 0.10 \Omega)$
		high voltage pulse 10 kV; 1 nF; 50 x 12/min	for R _n > 3.3 kΩ	$\Delta R/R \text{ max.: } \pm 20 \%$ (typical value ± 10 %)
		12 kV ESD test; 100 pulses	ESD contact discharge	$\Delta R/R \text{ max.: } \pm 20 \%$ (typical value: ± 10 %)
4.26		active flammability "cheese-cloth test"	5 x P _{nRMS} duration 5 min	no flaming of gauze cylinder
OTHER TEST IN ACCORDANCE WITH IEC 60695				
2.2		passive flammability "needle-flame test"	application of test flame for 20 s	no ignition of product no ignition of under-layer burning time less than 30 s

High Ohmic (up to 22 MΩ)/ High Voltage (up to 1.6 kV) Resistors



A metal glazed film is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned electrolytic copper wires are welded to the end-caps. The resistors are coated with a light blue lacquer which provides electrical, mechanical, and climatic protection. The encapsulation is resistant to all cleaning solvents in accordance with "MIL-STD 202E, method 215" and "IEC 60068-2-45".

FEATURES

- High pulse loading capability (up to 7 kV)
- Small size (0204)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- Where high resistance, high stability and high reliability at high voltage are required
- High humidity environment
- White goods
- Power supplies

TECHNICAL SPECIFICATIONS	
DESCRIPTION	VALUE
Resistance Range ⁽¹⁾	100 kΩ to 22 MΩ
Resistance Tolerance and Series: 100 kΩ to 15 MΩ 15 MΩ to 22 MΩ	± 1 %: E24/E96 series; ± 5 %: E24 series ± 5 %: E24 series; ± 10 %: E12 series
Maximum Dissipation at $T_{amb} = 70\text{ °C}$	0.25 W
Thermal Resistance, R_{th}	140 K/W
Temperature Coefficient	$\leq \pm 200 \times 10^{-6}/K$
Maximum Permissible Voltage:	
DC	1600 V
RMS	1150 V
Dielectric Withstanding Voltage of the Insulation for 1 Min	700 V
Basic Specifications	IEC 60115-1B
Climatic Category (IEC 60068)	55/155/56
Stability After:	
Load (1000 h)	$\Delta R \text{ max.: } \pm (1.5\% R + 0.1 \Omega)$
Accelerated Damp Heat Test (6 Days)	$\Delta R \text{ max.: } \pm (1.5\% R + 0.1 \Omega)$
Long Term Damp Heat Test (56 Days)	$\Delta R \text{ max.: } \pm (1.5\% R + 0.1 \Omega)$
Noise	max. 5 $\mu V/V$

Note:

⁽¹⁾ Ohmic values (other than resistance range) are available on request.

12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 2322 241
- The subsequent:
first digit for 1 % tolerance products (E24 and E96 series) or 2 digits for 5 % (E24 series) and 10 % (E12 series) indicate the resistor type and packing.
- The remaining digits indicate the resistance value:
 - The first 3 digits for 1 % or 2 digits for 5 and 10 % tolerance products indicate the resistance value.
 - The last digit indicates the resistance decade.

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
100 to 976 kΩ	4
1 to 9.76 MΩ	5
$\geq 10\text{ M}\Omega$	6

12NC Example

The 12NC for a VR25, resistor value 7.5 MΩ, 5 % tolerance, supplied on a bandolier of 1000 units in ammpack, is: 2322 241 13755.



High Ohmic (up to 22 MΩ)/
High Voltage (up to 1.6 kV) Resistors

Vishay BCcomponents

12NC - resistor type and packaging						
TYPE	TOL. (%)	ORDERING CODE 2322 241				
		BANDOLIER IN AMMOPACK				BANDOLIER ON REEL
		RADIAL TAPED	STRAIGHT LEADS			
		4000 units	52 mm	26 mm	52 mm	52 mm
VR25	± 1	0...	8...	-	7...	6...
	± 5	36...	13...	43...	53...	23...
	± 10	38...	12...	42...	52...	22...

PART NUMBER

PART NUMBER: VR25000001503JA100

V	R	2	5	0	0	0	0	0	1	5	0	3	J	A	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MODEL/SIZE VR25000	SPECIAL CHARACTER 0 = Neutral Z = Value overflow (Special)	TCR/MATERIAL 0 = Standard	VALUE 3 digit value 1 digit multiplier MULTIPLIER 3 = *10 ³ 4 = *10 ⁴ 5 = *10 ⁵	TOLERANCE F = ± 1 % J = ± 5 % K = ± 10 %	PACKAGING (1) A5 A2 A1 R5 N4	SPECIAL The 2 digits are used for all special parts. 00 = Standard
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PRODUCT DESCRIPTION: VR25 5 % A1 150K

VR25 MODEL/SIZE VR25	5 % TOLERANCE ± 1 % ± 5 % ± 10 %	A1 PACKAGING (1) A5 A2 A1 R5 N4	150K RESISTANCE VALUE 150K = 150 kΩ 8M2 = 8.2 MΩ
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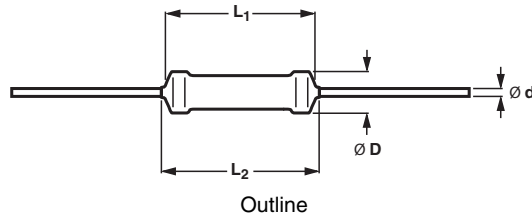
Notes:

(1) Please refer to table PACKAGING

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

PACKAGING			
CODE	PIECES	DESCRIPTION	MODEL/SIZE
A5	5000	Bandolier in ammpack straight leads 52 mm	VR25
A2	2000	Bandolier in ammpack straight leads 26 mm	
A1	1000	Bandolier in ammpack straight leads 52 mm	
R5	5000	Bandolier on reel straight leads 52 mm	
N4	4000	Bandolier in ammpack radial taped	

DIMENSIONS



DIMENSIONS - resistor type and relevant physical dimensions				
TYPE	Ø D _{max.}	L ₁ max.	L ₂ max.	Ø d
VR25	2.5	6.5	7.5	0.58 ± 0.05

MASS PER 100 UNITS	
TYPE	MASS (g)
VR25 52 mm	21.2
VR25 26 mm	14.8

Yellow and grey are used instead of gold and silver because metal particles in the lacquer could affect high-voltage properties.

OUTLINES

The length of the body (L₁) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation (“IEC publication 60294”).

MARKING

The nominal resistance and tolerance are marked on the resistor using four or five colored bands in accordance with IEC publication 60062 “Color codes for fixed resistors”.

FUNCTIONAL PERFORMANCE

PRODUCT CHARACTERIZATION

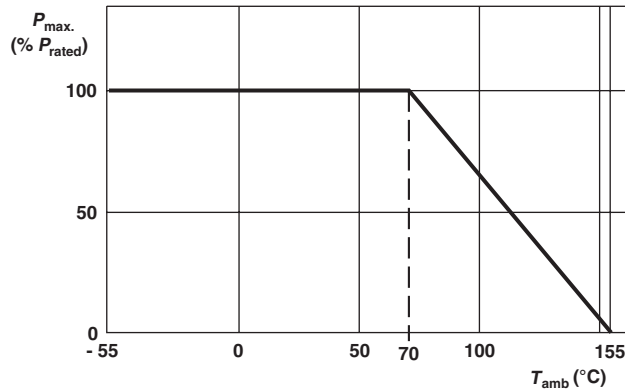
Standard values of nominal resistance are taken from the E96/E24/E12 series for resistors with a tolerance of ± 1 %, 5 % or 10 %. The values of the E96/E24/E12 series are in accordance with “IEC publication 60063”.

LIMITING VALUES			
TYPE	LIMITING VOLTAGE ⁽¹⁾ (V)		LIMITING POWER (W)
	DC	RMS	
VR25	1600	1150	0.25

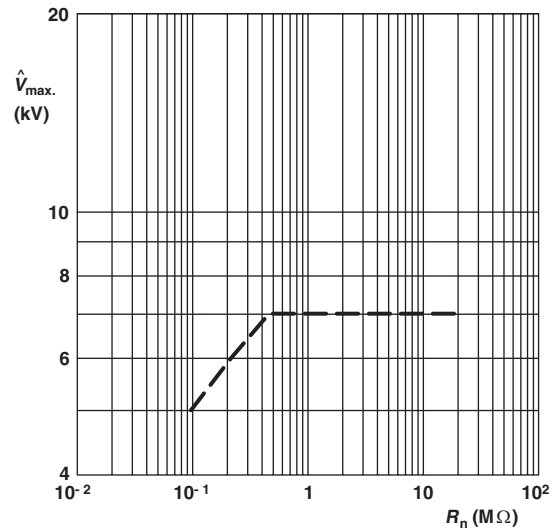
Notes:

- ⁽¹⁾ The maximum voltage that may be continuously applied to the resistor element, see “IEC publication 60115-1”
- The maximum permissible hot-spot temperature is 155 °C

The power that the resistor can dissipate depends on the operating temperature.



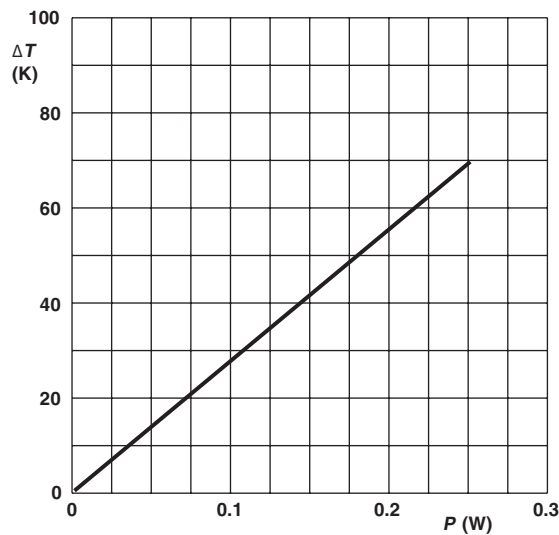
Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb})



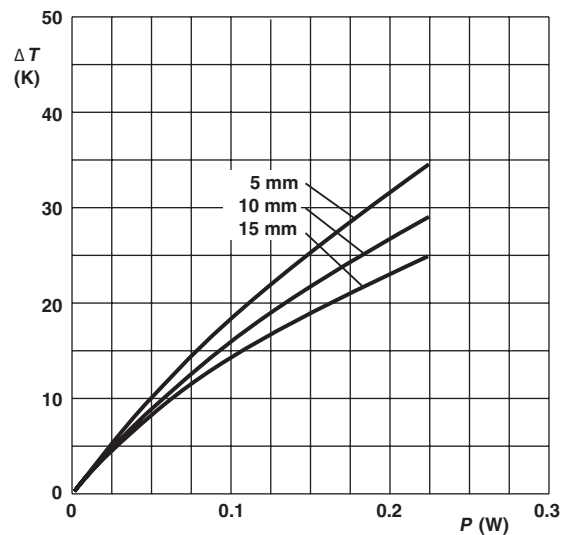
Maximum allowed peak pulse voltage in accordance with "IEC 60065 chapter 14.1"; 50 discharges from a 1 nF capacitor charged to \hat{V}_{max} ; 12 discharges/min (drift $\Delta R/R \leq 2\%$)

Derating

Pulse Loading Capability



Hot-spot temperature rise (ΔT) as a function of dissipated power



Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting

Application Information

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-1", category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 60068-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and

under standard atmospheric conditions according to "IEC 60068-1", subclause 5.3.

In the Test Procedures and Requirements table the tests and requirements are listed with reference to the relevant clauses of "IEC publications 60115-1 and 60068-2"; a short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying.

All soldering tests are performed with mildly activated flux.

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.16	21 (U)	robustness of terminations:		
4.16.2	21 (Ua1)	tensile all samples	\varnothing 0.6 mm; load 10 N; 10 s	number of failures < 10×10^{-6}
4.16.3	21 (Ub)	bending half number of samples	\varnothing 0.6 mm; load 5 N; 4 x 90°	number of failures < 10×10^{-6}
4.16.4	21 (Uc)	torsion other half of samples	3 x 360° in opposite directions	no damage ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.17	20 (Ta)	solderability	2 s; 235 °C	good tinning; no damage
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 3 mm from body	ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.19	14 (Na)	rapid change of temperature	30 min at - 55 °C and 30 min at + 155 °C; 5 cycles	ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.20	29 (Eb)	bump	3 x 1500 bumps in 3 directions; 40 g	no damage ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.22	6 (Fc)	vibration	frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 h (3 x 2 h)	no damage ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$



High Ohmic (up to 22 MΩ)/
High Voltage (up to 1.6 kV) Resistors

Vishay BCcomponents

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	16 h; 155 °C	
4.23.3	30 (Db)	damp heat (accelerated) 1 st cycle	24 h; 55 °C; 90 to 100 % RH	
4.23.4	1 (Aa)	cold	2 h; - 55 °C	
4.23.5	13 (M)	low air pressure	2 h; 8.5 kPa; 15 to 35 °C	
4.23.6	30 (Db)	damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 to 100 % RH	R_{ins} min.: 10 ³ MΩ ΔR max.: ± (1.5 % R + 0.1 Ω)
4.24.2	3 (Ca)	damp heat (steady state)	56 days; 40 °C; 90 to 95 % RH; dissipation 0.01 Pn; limiting voltage 100 V (DC)	ΔR max.: ± (1.5 % R + 0.1 Ω)
4.25.1		endurance	1000 h at 70 °C; Pn or V _{max.}	ΔR max.: ± (1.5 % R + 0.1 Ω)
4.8.4		temperature coefficient	between - 55 °C and + 155 °C (TCR x 10 ⁻⁶ /K)	≤ ± 200
4.7		voltage proof on insulation	700 V _{RMS} during 1 min; V-block method	no breakdown
4.12		noise	"IEC publication 60195"	max. 5 μV/V
4.6.1.1		insulation resistance	500 V (DC) during 1 min; V-block method	R_{ins} min.: 10 ⁴ MΩ
4.13		short time overload	room temperature; dissipation 6.25 x Pn (voltage not more than 2 x limiting voltage); 10 cycles; 5 s ON and 45 s OFF	ΔR max.: ± (2.0 % R + 0.05 Ω)
4.26		active flammability "cheese-cloth test"	steps of: 5/10/16/25/40 x Pn _{RMS} duration 5 min	no flaming of gauze cylinder
OTHER TEST IN ACCORDANCE WITH IEC 60695				
2.2		passive flammability "needle-flame test"	application of test flame for 20 s	no ignition of product; no ignition of under-layer; burning time less than 30 s

High Ohmic (up to 33 M Ω)/ High Voltage (up to 3.5 kV) Resistors



A metal glazed film is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned electrolytic copper wires are welded to the end-caps. The resistors are coated with a light blue lacquer which provides electrical, mechanical, and climatic protection.

The encapsulation is resistant to all cleaning solvents in accordance with "MIL-STD 202E, method 215" and "IEC 60068-2-45".

FEATURES

- Lead (Pb)-free solder contacts
- These resistors meet the safety requirements of:
 - "UL1676" (510 k Ω to 11 M Ω); File No: E171160
 - "IEC 60065"
 - "EN60065"
 - "VDE 0860" (Germany)
 - "CQC" (China)
- High pulse loading capability (10 kV)
- Small size (0309)
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- Where high resistance, high stability and high reliability at high voltage are required
- Safety component in combination with high voltage
- White goods
- High humidity environment
- Power supplies

TECHNICAL SPECIFICATIONS

DESCRIPTION	VALUE
Resistance Range ⁽¹⁾	100 k Ω to 33 M Ω
Resistance Tolerance and Series	$\pm 1\%$: E24/E96 series; $\pm 5\%$: E24 series
Maximum Dissipation at $T_{amb} = 70\text{ }^{\circ}\text{C}$	0.5 W
Thermal Resistance, R_{th}	120 K/W
Temperature Coefficient	$\leq \pm 200 \times 10^{-6}/\text{K}$
Maximum Permissible Voltage:	
DC	3500 V
RMS	2500 V
Dielectric Withstanding Voltage of the Insulation for 1 Min	700 V
Basic Specifications	IEC 60115-1B
Safety Requirements	UL1676 (510 k Ω to 11 M Ω); EN60065; VDE 0860; CQC
Climatic Category (IEC 60068)	55/155/56
Stability After:	
Load (1000 h)	$\Delta R \text{ max.}: \pm (1.5\% R + 0.1 \Omega)$
Accelerated Damp Heat Test (6 Days)	$\Delta R \text{ max.}: \pm (1.5\% R + 0.1 \Omega)$
Long Term Damp Heat Test (56 Days)	$\Delta R \text{ max.}: \pm (1.5\% R + 0.1 \Omega)$
Noise	max. 2.5 $\mu\text{V/V}$

Note:

⁽¹⁾ Ohmic values (other than resistance range) are available upon request



12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 2322 242.
- The subsequent:
 - first digit for 1 % tolerance products (E24 and E96 series) or 2 digits for 5 % (E24 series) indicate the resistor type and packaging
- The remaining digits indicate the resistance value:
 - The first 3 digits for 1 % or 2 digits for 5 % tolerance products indicate the resistance value
 - The last digit indicates the resistance decade

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
100 to 976 kΩ	4
1 to 9.76 MΩ	5
≥ 10 MΩ	6

12NC Example

The 12NC for a VR37, resistor value 7.5 MΩ, 5 % tolerance, supplied on a bandolier of 1000 units in ammpack, is: 2322 242 13755.

12NC - resistor type and packaging				
TYPE	TAPE WIDTH (mm)	TOL. (%)	ORDERING CODE 2322 242	
			BANDOLIER IN AMMOPACK	BANDOLIER ON REEL
			1000 units	5000 units
VR37	52	± 1	8...	6...
		± 5	13...	23...

PART NUMBER

PART NUMBER: VR3700001503JA100

V	R	3	7	0	0	0	0	0	1	5	0	3	J	A	1	0	0
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MODEL/SIZE VR37000	SPECIAL CHARACTER 0 = Neutral Z = Value overflow (Special)	TCR/MATERIAL 0 = Standard	VALUE 3 digit value 1 digit multiplier MULTIPLIER 3 = *10 ³ 4 = *10 ⁴ 5 = *10 ⁵	TOLERANCE F = ± 1 % J = ± 5 %	PACKAGING ⁽¹⁾ A1 R5	SPECIAL The 2 digits are used for all special parts. 00 = Standard
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PRODUCT DESCRIPTION: VR37 5 % A1 150K

VR37	5 %	A1	150K
MODEL/SIZE VR37	TOLERANCE ± 1 % ± 5 %	PACKAGING ⁽¹⁾ A1 R5	RESISTANCE VALUE 150K = 150 kΩ 8M2 = 8.2 MΩ

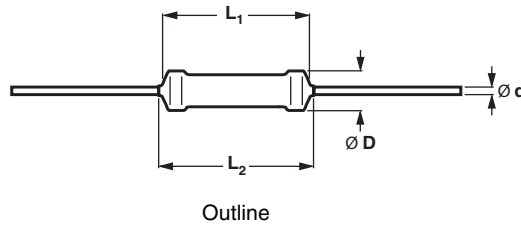
Notes:

⁽¹⁾ Please refer to table PACKAGING

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

PACKAGING			
CODE	PIECES	DESCRIPTION	MODEL/SIZE
A1	1000	Bandolier in ammpack straight leads 52 mm	VR37
R5	5000	Bandolier on reel straight leads 52 mm	

DIMENSIONS



DIMENSIONS - resistor type and relevant physical dimensions				
TYPE	Ø D _{max.}	L ₁ max.	L ₂ max.	Ø d
VR37	4.0	9.0	10.0	0.7 ± 0.03

MASS PER 100 UNITS	
TYPE	MASS (g)
VR37	45.7

Yellow and grey are used instead of gold and silver because metal particles in the lacquer could affect high-voltage properties.

OUTLINES

The length of the body (L₁) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation (“IEC publication 60294”).

MARKING

The nominal resistance and tolerance are marked on the resistor using four or five colored bands in accordance with IEC publication 60062 “Color codes for fixed resistors”.

FUNCTIONAL PERFORMANCE

PRODUCT CHARACTERIZATION

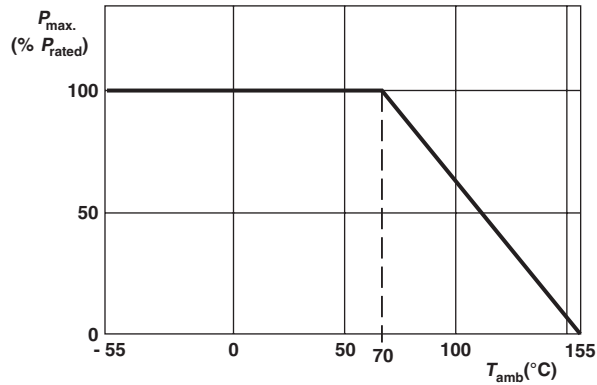
Standard values of nominal resistance are taken from the E96/E24/E12 series for resistors with a tolerance of ± 1 % or 5 %. The values of the E96/E24 series are in accordance with “IEC publication 60063”.

LIMITING VALUES			
TYPE	LIMITING VOLTAGE ⁽¹⁾ (V)		LIMITING POWER (W)
	DC	RMS	
VR37	3500	2500	0.5

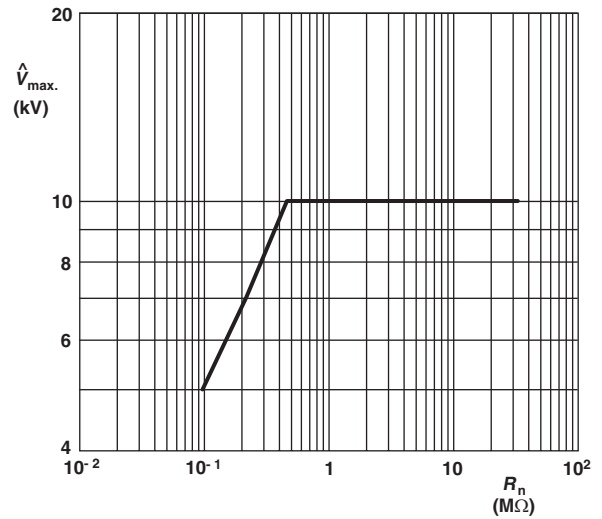
Notes:

- ⁽¹⁾ The maximum voltage that may be continuously applied to the resistor element, see “IEC publication 60115-1”
- The maximum permissible hot-spot temperature is 155 °C

The power that the resistor can dissipate depends on the operating temperature.

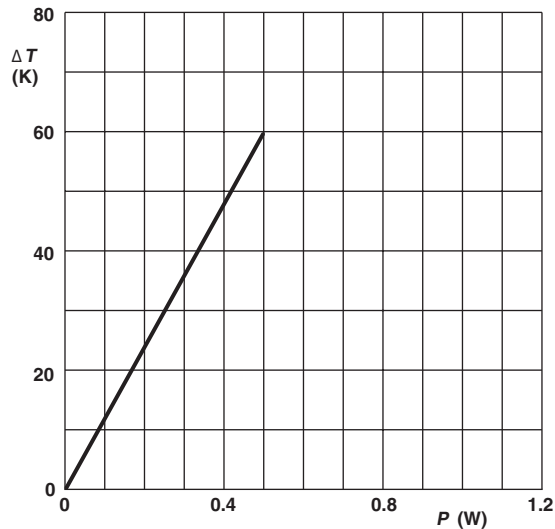


Maximum dissipation ($P_{max.}$) in percentage of rated power as a function of the ambient temperature (T_{amb})



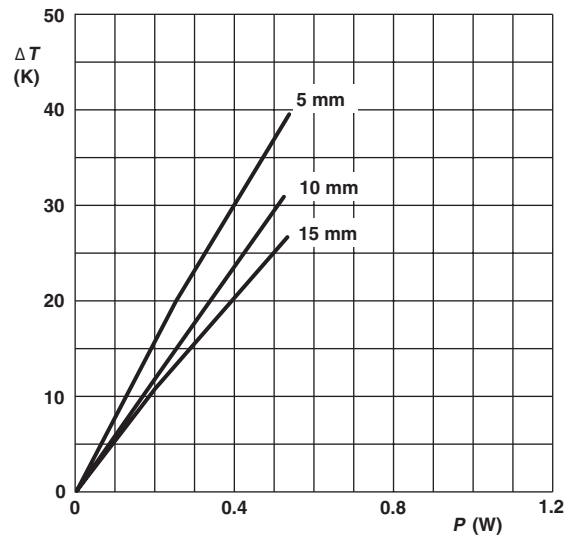
Maximum allowed peak pulse voltage in accordance with "IEC 60065 chapter 14.1"; 50 discharges from a 1 nF capacitor charged to $\hat{V}_{max.}$; 12 discharges/minute (drift $\Delta R/R \leq 2\%$)

Derating



Hot-spot temperature rise (ΔT) as a function of dissipated power

Pulse Loading Capability



Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting

Application Information

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-1", category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 60068-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and

under standard atmospheric conditions according to "IEC 60068-1", subclause 5.3.

In the Test Procedures and Requirements table the tests and requirements are listed with reference to the relevant clauses of "IEC publications 60115-1 and 60068-2"; a short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying.

All soldering tests are performed with mildly activated flux.

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.16	21 (U)	robustness of terminations:		
4.16.2	21 (Ua1)	tensile all samples	\varnothing 0.7 mm; load 10 N; 10 s	number of failures < 10×10^{-6}
4.16.3	21 (Ub)	bending half number of samples	\varnothing 0.7 mm; load 5 N; 4 x 90°	number of failures < 10×10^{-6}
4.16.4	21 (Uc)	torsion other half of samples	3 x 360° in opposite directions	no damage ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.17	20 (Ta)	solderability	2 s; 235 °C	good tinning; no damage
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 3 mm from body	ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.19	14 (Na)	rapid change of temperature	30 min at - 55 °C and 30 min at + 155 °C; 5 cycles	ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.20	29 (Eb)	bump	3 x 1500 bumps in 3 directions; 40 g	no damage ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.22	6 (Fc)	vibration	frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 h (3 x 2 h)	no damage ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	16 h; 155 °C	
4.23.3	30 (Db)	damp heat (accelerated) 1 st cycle	24 h; 55 °C; 90 to 100 % RH	
4.23.4	1 (Aa)	cold	2 h; - 55 °C	
4.23.5	13 (M)	low air pressure	2 h; 8.5 kPa; 15 to 35 °C	
4.23.6	30 (Db)	damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 to 100 % RH	R_{ins} min.: 10^3 M Ω ΔR max.: $\pm (1.5 \% R + 0.1 \Omega)$



TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.24.2	3 (Ca)	damp heat (steady state)	56 days; 40 °C; 90 to 95 % RH; dissipation 0.01 P _n ; limiting voltage 100 V (DC)	ΔR max.: $\pm (1.5 \% R + 0.1 \Omega)$
4.25.1		endurance	1000 h at 70 °C; P _n or V _{max} .	ΔR max.: $\pm (1.5 \% R + 0.1 \Omega)$
4.8.4		temperature coefficient	between - 55 °C and + 155 °C (TC x 10 ⁻⁶ /K)	$\leq \pm 200$
4.7		voltage proof on insulation	700 V _{RMS} during 1 min; V-block method	no breakdown
4.12		noise	"IEC publication 60195"	max. 2.5 μ V/V
4.6.1.1		insulation resistance	500 V (DC) during 1 min; V-block method	R _{ins} min.: 10 ⁴ M Ω
4.13		short time overload	room temperature; dissipation 6.25 x P _n (voltage not more than 2 x limiting voltage); 10 cycles; 5 s ON and 45 s OFF	ΔR max.: $\pm (2.0 \% R + 0.05 \Omega)$

High Ohmic (up to 68 M Ω)/ High Voltage (up to 10 kV) Resistors



A metal glazed film is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned electrolytic copper wires are welded to the end-caps. The resistors are coated with a light blue lacquer which provides electrical, mechanical, and climatic protection.

The encapsulation is resistant to all cleaning solvents in accordance with "MIL-STD 202E, method 215" and "IEC 60068-2-45".

FEATURES

- Lead (Pb)-free solder contacts
- These resistors meet the safety requirements of:
 - "UL1676" (510 k Ω to 11 M Ω); File No: E171160
 - "IEC 60065"
 - "EN60065"
 - "VDE 0860" (Germany)
 - "CQC" (China)
- High pulse loading capability (10 kV)
- Small size (0718)
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- Where high resistance, high stability and high reliability at high voltage are required
- Safety component in combination with high voltage
- Picture tubes
- High voltage bleeders
- Cascade switches

TECHNICAL SPECIFICATIONS	
DESCRIPTION	VALUE
Resistance Range ⁽¹⁾	100 k Ω to 68 M Ω
Resistance Tolerance and Series	$\pm 1\%$: E24/E96 series; $\pm 5\%$: E24 series
Maximum Dissipation at $T_{amb} = 70\text{ }^{\circ}\text{C}$	1 W
Thermal Resistance, R_{th}	70 K/W
Temperature Coefficient	$\leq \pm 200 \times 10^{-6}/\text{K}$
Maximum Permissible Voltage:	
DC	10 000 V
RMS	7000 V
Dielectric Withstanding Voltage of the Insulation for 1 Min	700 V
Basic Specifications	IEC 60115-1B
Safety Requirements	UL1676 (510 k Ω to 11 M Ω); EN60065; VDE 0860; CQC
Climatic Category (IEC 60068)	55/155/56
Stability After:	
Load (1000 h)	$\Delta R \text{ max.}: \pm (1.5\% R + 0.1 \Omega)$
Accelerated Damp Heat Test (6 Days)	$\Delta R \text{ max.}: \pm (1.5\% R + 0.1 \Omega)$
Long Term Damp Heat Test (56 Days)	$\Delta R \text{ max.}: \pm (1.5\% R + 0.1 \Omega)$
Noise	max. 2.5 $\mu\text{V/V}$

Note:

⁽¹⁾ Ohmic values (other than resistance range) are available upon request



12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 2322 244
- The subsequent:
first digit for 1 % tolerance products (E24 and E96 series) or 2 digits for 5 % (E24 series) indicate the resistor type and packing
- The remaining digits indicate the resistance value:
 - The first 3 digits for 1 % or 2 digits for 5 % tolerance products indicate the resistance value
 - The last digit indicates the resistance decade

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
100 to 976 kΩ	4
1 to 9.76 MΩ	5
≥ 10 MΩ	6

12NC Example

The 12NC for a VR68, resistor value 7.5 MΩ, 5 % tolerance, supplied on a bandolier of 500 units in ammpack, is: 2322 244 13755.

12NC - resistor type and packaging				
TYPE	TAPE WIDTH (mm)	TOL. (%)	ORDERING CODE 2322 244	
			BANDOLIER IN AMMOPACK	BANDOLIER ON REEL
			500 units	750 units
VR68	66.7	± 1	8....	6....
		± 5	13...	23...

PART NUMBER

PART NUMBER: VR6800001503JAC00

V	R	6	8	0	0	0	0	0	1	5	0	3	J	A	C	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING (1)	SPECIAL
VR68000	0 = Neutral Z = Value overflow (Special)	0 = Standard	3 digit value 1 digit multiplier MULTIPLIER 3 = *10 ³ 4 = *10 ⁴ 5 = *10 ⁵	F = ± 1 % J = ± 5 %	AC RD	The 2 digits are used for all special parts. 00 = Standard

PRODUCT DESCRIPTION: VR68 5 % AC 150K

VR68	5 %	AC	150K
MODEL/SIZE	TOLERANCE	PACKAGING (1)	RESISTANCE VALUE
VR68	± 1 % ± 5 %	AC RD	150K = 150 kΩ 8M2 = 8.2 MΩ

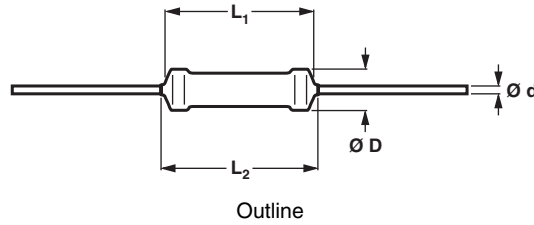
Notes:

(1) Please refer to table PACKAGING for details

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

PACKAGING			
CODE	PIECES	DESCRIPTION	MODEL/SIZE
AC	500	Bandolier in ammpack straight leads	VR68
RD	750	Bandolier on reel straight leads	

DIMENSIONS



DIMENSIONS - resistor type and relevant physical dimensions				
TYPE	Ø D _{max.}	L ₁ max.	L ₂ max.	Ø d
VR68	6.8	18.0	19.0	0.78 ± 0.05

MASS PER 100 UNITS	
TYPE	MASS (g)
VR68	169.1

Yellow and grey are used instead of gold and silver because metal particles in the lacquer could affect high-voltage properties.

MARKING

The nominal resistance and tolerance are marked on the resistor using four or five colored bands in accordance with IEC publication 60062 “Color codes for fixed resistors”.

OUTLINES

The length of the body (L₁) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation (“IEC publication 60294”).

FUNCTIONAL PERFORMANCE

PRODUCT CHARACTERIZATION

Standard values of nominal resistance are taken from the E96/E24/E12 series for resistors with a tolerance of ± 1 % or

5 %. The values of the E96/E24 series are in accordance with “IEC publication 60063”.

LIMITING VALUES			
TYPE	LIMITING VOLTAGE ⁽¹⁾ (V)		LIMITING POWER (W)
	DC	RMS	
VR68	10 000	7000	1.0

Notes:

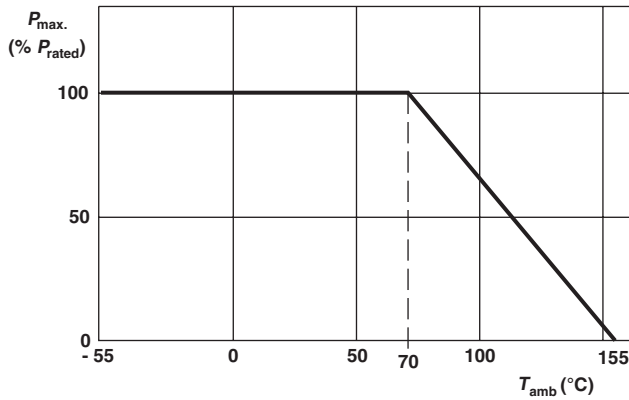
- ⁽¹⁾ The maximum voltage that may be continuously applied to the resistor element, see “IEC publication 60115-1”
- The maximum permissible hot-spot temperature is 155 °C



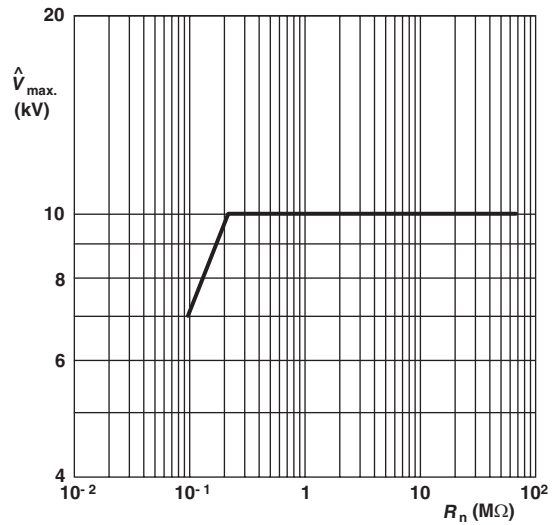
High Ohmic (up to 68 MΩ)/
High Voltage (up to 10 kV) Resistors

Vishay BCcomponents

The power that the resistor can dissipate depends on the operating temperature.



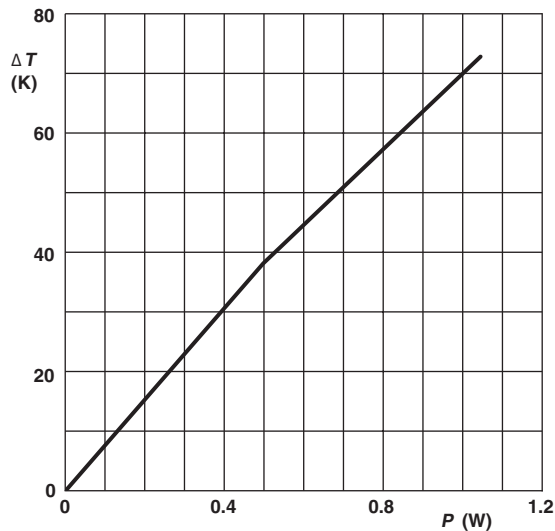
Maximum dissipation ($P_{max.}$) in percentage of rated power as a function of the ambient temperature (T_{amb})



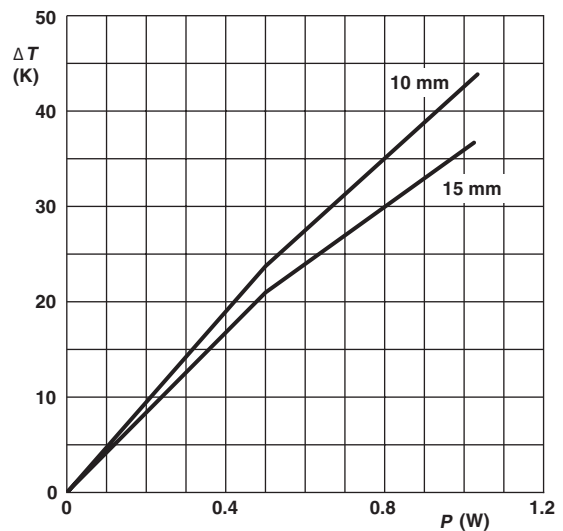
Maximum allowed peak pulse voltage in accordance with "IEC 60065 chapter 14.1"; 50 discharges from a 1 nF capacitor charged to $\hat{V}_{max.}$; 12 discharges/minute (drift $\Delta R/R \leq 2\%$)

Derating

Pulse Loading Capability



Hot-spot temperature rise (ΔT) as a function of dissipated power



Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting

Application Information

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of “IEC publication 60115-1”, category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 60068-2, “Recommended basic climatic and mechanical robustness testing procedure for electronic components” and

under standard atmospheric conditions according to “IEC 60068-1”, subclause 5.3.

In the Test Procedures and Requirements table the test and requirements are listed with reference to the relevant clauses of “IEC publications 60115-1 and 60068-2”; a short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying.

All soldering tests are performed with mildly activated flux.

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.16	21 (U)	robustness of terminations:		
4.16.2	21 (Ua1)	tensile all samples	Ø 0.8 mm; load 10 N; 10 s	number of failures < 10 x 10 ⁻⁶
4.16.3	21 (Ub)	bending half number of samples	Ø 0.8 mm; load 5 N; 4 x 90°	number of failures < 10 x 10 ⁻⁶
4.16.4	21 (Uc)	torsion other half of samples	3 x 360° in opposite directions	no damage ΔR max.: ± (0.5 % R + 0.05 Ω)
4.17	20 (Ta)	solderability	2 s; 235 °C	good tinning; no damage
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 3 mm from body	ΔR max.: ± (0.5 % R + 0.05 Ω)
4.19	14 (Na)	rapid change of temperature	30 min at - 55 °C and 30 min at + 155 °C; 5 cycles	ΔR max.: ± (0.5 % R + 0.05 Ω)
4.20	29 (Eb)	bump	3 x 1500 bumps in 3 directions; 40 g	no damage ΔR max.: ± (0.5 % R + 0.05 Ω)
4.22	6 (Fc)	vibration	frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 h (3 x 2 h)	no damage ΔR max.: ± (0.5 % R + 0.05 Ω)
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	16 h; 155 °C	
4.23.3	30 (Db)	damp heat (accelerated) 1 st cycle	24 h; 55 °C; 90 to 100 % RH	
4.23.4	1 (Aa)	cold	2 h; - 55 °C	
4.23.5	13 (M)	low air pressure	2 h; 8.5 kPa; 15 to 35 °C	



TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.23.6	30 (Db)	damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 to 100 % RH	R_{ins} min.: 10 ³ M Ω ΔR max.: $\pm (1.5 \% R + 0.1 \Omega)$
4.24.2	3 (Ca)	damp heat (steady state)	56 days; 40 °C; 90 to 95 % RH; dissipation 0.01 P _n ; limiting voltage 100 V (DC)	ΔR max.: $\pm (1.5 \% R + 0.1 \Omega)$
4.25.1		endurance	1000 h at 70 °C; P _n or V _{max} .	ΔR max.: $\pm (1.5 \% R + 0.1 \Omega)$
4.8.4		temperature coefficient	between - 55 °C and + 155 °C (TC x 10 ⁻⁶ /K)	$\leq \pm 200$
4.7		voltage proof on insulation	700 V _{RMS} during 1 min; V-block method	no breakdown
4.12		noise	"IEC publication 60195"	max. 2.5 μ V/V
4.6.1.1		insulation resistance	500 V (DC) during 1 min; V-block method	R_{ins} min.: 10 ⁴ M Ω
4.13		short time overload	room temperature; dissipation 6.25 x P _n (voltage not more than 2 x limiting voltage; 10 000 V max.); 10 cycles; 5 s ON and 45 s OFF	ΔR max.: $\pm (2.0 \% R + 0.05 \Omega)$

Standard High Ohmic (up to 15 M Ω) High Voltage (up to 6 kV) Resistors



A metal glazed film is deposited on a high grade ceramic body. After a helical groove is cut in the resistive layer, connecting wires of electrolytic copper plated with 100 % pure tin are welded to the termination caps.

The resistors are coated with a light blue lacquer which provides electrical, mechanical and climatic protection. The encapsulation is resistant to all cleaning solvents in accordance with "MIL-STD 202 E method 215" and "IEC 60068-2-45."

FEATURES

- Lead (Pb)-free solder contacts
- These resistors meet the safety requirements of:
 - "UL1676" (510 k Ω - 11 M Ω); File No: E171160
 - "IEC 60065"
 - "EN60065"
 - "VDE 0860"
- High working voltage (up to 6 kV), high pulse loading capability
- Metal glaze thick film resistive element
- Good stability and reliability
- Available in E24/E96 series
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- High Resistance, High Voltage applications
- Televisions and Monitors
- Power Supplies
- Electronic Ballast
- White Goods

TECHNICAL SPECIFICATIONS	
DESCRIPTION	SVR52
DIN Size	0617
Resistance Range ⁽¹⁾	100 k Ω - 15 M Ω
Resistance Tolerance and Series	$\pm 5\%$: E24 Series, $\pm 1\%$: E24/E96 Series
Max. Rated Dissipation, P_{70}	1.0 W
Thermal Resistance, R_{th}	80 K/W
Temperature Coefficient	$\leq 350 \times 10^{-6}$ /K
Operating Voltage, U_{max} . AC/DC ⁽²⁾	6000 V _{DC} /4200 V _{RMS}
Dielectric Withstanding Voltage of Insulation for 1 Min	500 V
Climatic Category (LCT/UCT/Days) (IEC 60068)	55/155/56
Basic Specifications	IEC 60115-B
Stability, $\Delta R/R$ max., After:	
Load (1000 h)	$\pm (5\% R \pm 0.1 \Omega)$
Accelerated Damp Heat Test (6 Days)	$\pm (2\% R \pm 0.1 \Omega)$
Long Term Damp Heat Test (56 Days)	$\pm (5\% R \pm 0.1 \Omega)$

Notes:

⁽¹⁾ Ohmic values (other than resistance range) are available on request

⁽²⁾ Limiting element voltage is $\sqrt{P \times R}$



Standard High Ohmic (up to 15 MΩ) Vishay BCcomponents
High Voltage (up to 6 kV) Resistors

12NC INFORMATION

- The resistors have a 12-digit ordering code starting with 2322 248.
- The subsequent first digit for 1 % tolerance products (E24 and E96 series) or 2 digits for 5 % (E24 series) indicate the resistor type and packing.
- The remaining digits indicate the resistance value. The first three digits for 1 % or 2 digits for 5 % tolerance products indicate the resistance value. The last digit indicates the resistance in decade.

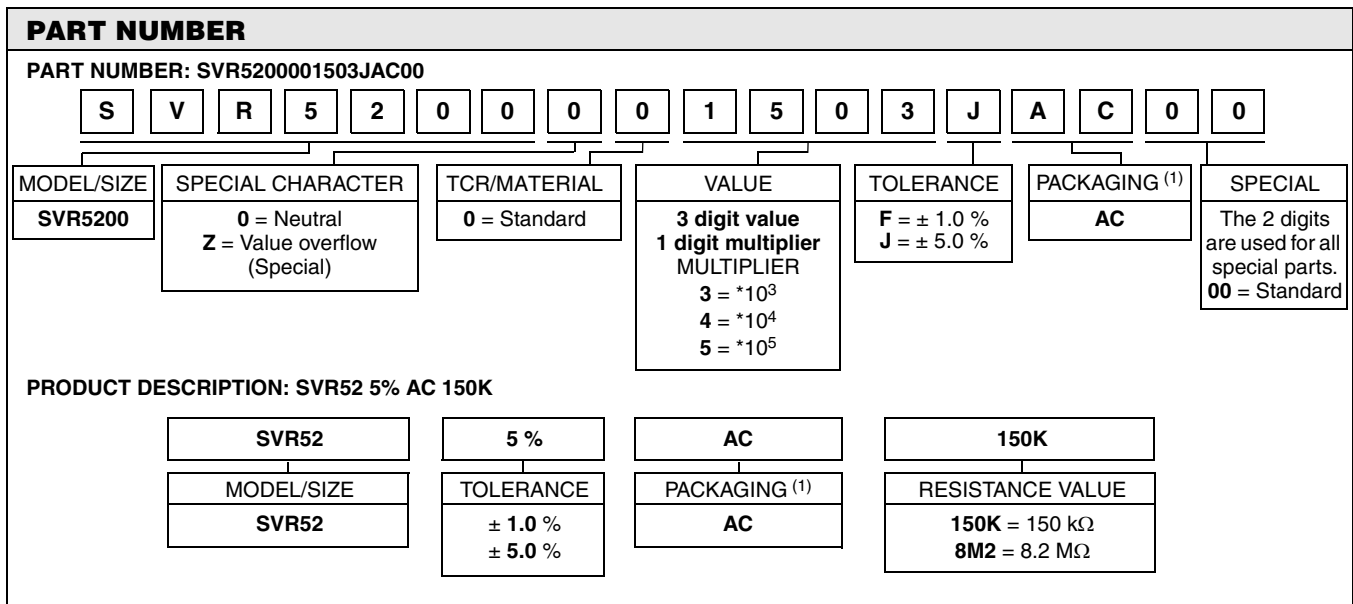
Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
100 kΩ to 976 kΩ	4
1 MΩ to 9.76 MΩ	5
10 MΩ	6

12NC Example

The 12NC of a SVR52 resistor value 8.2MΩ with tolerance of ± 5 % and supplied on a bandolier of 500 units in ammpack is 2322 248 13825.

12NC - resistor type and packaging			
DESCRIPTION			ORDERING CODE 2322 248
			BANDOLIER IN AMMOPACK
TYPE	TAPE WIDTH (mm)	TOL. (%)	500 units
SVR52	63	± 1 %	8...
		± 5 %	13...



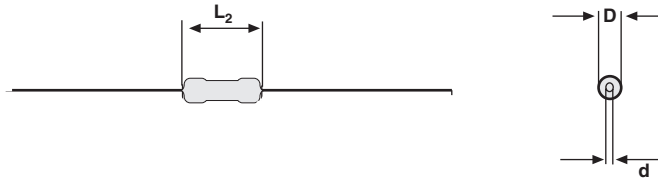
Notes:

(1) Please refer to table PACKAGING

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

PACKAGING			
CODE	PIECES	DESCRIPTION	MODEL/SIZE
AC	500	Bandolier in ammpack straight leads 63 mm	SVR52

DIMENSIONS



DIMENSIONS - leaded resistor type and relevant physical dimensions			
TYPE	D ₁ max. (mm)	L ₂ max. (mm)	d _{nom.} (mm)
SVR 52	5.2	19.5	0.8

MASS PER 100 UNITS	
TYPE	MASS (g)
SVR 52	111.2

MARKING

The nominal resistance and tolerance are marked on the resistor using four or five color bands in accordance with "IEC publication 60062" color codes for fixed resistors. Yellow and grey colors are used instead of gold and silver because metal particles in lacquer could affect high voltage properties.

**FUNCTIONAL PERFORMANCE
PRODUCT CHARACTERIZATION**

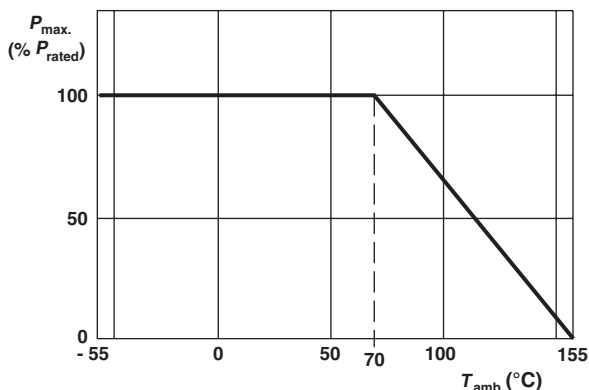
Standard values of nominal resistance are taken from the E24/E96 series for resistors with tolerance of $\pm 1\%$, $\pm 5\%$. The values of the E24/E96 series are in accordance with "IEC publication 60063"

LIMITING VALUES			
TYPE	LIMITING VOLTAGE (V)		LIMITING POWER (W)
	DC	RMS	
SVR52	6000	4200	1

Note:

(1) The maximum voltage that may be continuously applied to the resistor element is in accordance with "IEC publication 60115-1". The maximum permissible hot spot temperature is 155 °C.

The power that the resistor can dissipate depends on the operating temperature.



Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb})

Derating



Standard High Ohmic (up to 15 MΩ) Vishay BCcomponents
High Voltage (up to 6 kV) Resistors

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-1, category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper category Temperature, damp heat, long term, 56 days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 60068-2. "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and

under standard atmospheric conditions according to IEC 60068-1, subclause 5.3.

In the Test Procedures and Requirements table the tests and requirements are listed with reference to the relevant clauses of IEC publications 60115-1 and 60068-2; a short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying.

All soldering tests are performed with mildly activated flux.

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.16	21 (U)	robustness of terminations:		
4.16.2	21 (Ua1)	tensile all samples	load 10N; 10 s	number of failures: <math> < 10 \times 10^{-6}</math>
4.16.3	21 (Ub)	bending half number of samples	load 5N; 4 x 90°	number of failures: <math> < 10 \times 10^{-6}</math>
4.16.4	21 (Uc)	torsion other half number of samples	3 x 360° in opposite directions	no damage, ΔR max.: $\pm (1 \% R + 0.05 \Omega)$
4.17	20 (Ta)	solderability	2 s; 235 °C	good tinning; no damage
4.18	20 (Tb)	resistance to soldering heat	thermal shock; 3 s; 350 °C; 3 mm from body	ΔR max.: $\pm (2 \% R + 0.05 \Omega)$
4.19	14 (Na)	rapid change of temperature	30 min at - 55 °C and 30 min at + 155 °C; 5 cycles	ΔR max.: $\pm (2 \% R + 0.1 \Omega)$
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	16 h; 155 °C	
4.23.3	30 (Db)	damp heat (accelerated) 1st cycle	24 h; 55 °C; 90 to 100 % RH	
4.23.4	1 (Aa)	cold	2 h; - 55 °C	
4.23.5	13 (M)	low air pressure	2 h; 8.5 kPa; 15 - 35 °C	R_{ins} min.: 10^3 MΩ
4.23.6	30 (Db)	damp heat, (accelerated) remaining cycles	5 days; 55 °C; 95 to 100 % RH;	ΔR max.: $\pm (2 \% R + 0.1 \Omega)$
4.24.2	3 (Ca)	damp heat, (steady state)	56 days; 40 °C; 90 to 95 % RH; dissipation 0.01 Pn; limiting voltage 100 V (DC)	ΔR max.: $\pm (5 \% R + 0.1 \Omega)$
4.25.1	-	endurance at 70 °C	1000 h loaded with Pn or Vmax.	ΔR max.: $\pm (5 \% R + 0.1 \Omega)$
4.8.4	-	temperature coefficient	between - 55 °C to + 155 °C; (TC ppm/°C)	$\leq \pm 350$
4.7	-	voltage proof on insulation	500 VRMS during 1 min; V-block method	no breakdown
4.6.1.1	-	insulation resistance	500 V (DC) during 1 min; V-block method	R_{ins} min.: 10^4 MΩ
4.13	-	short time overload	room temperature; dissipation 6.25 x Pn (voltage not more than 2 x limiting voltage); 10 cycles; 5 s ON and 45 s OFF	ΔR max.: $\pm (2 \% R + 0.1 \Omega)$





Carbon Film Resistors

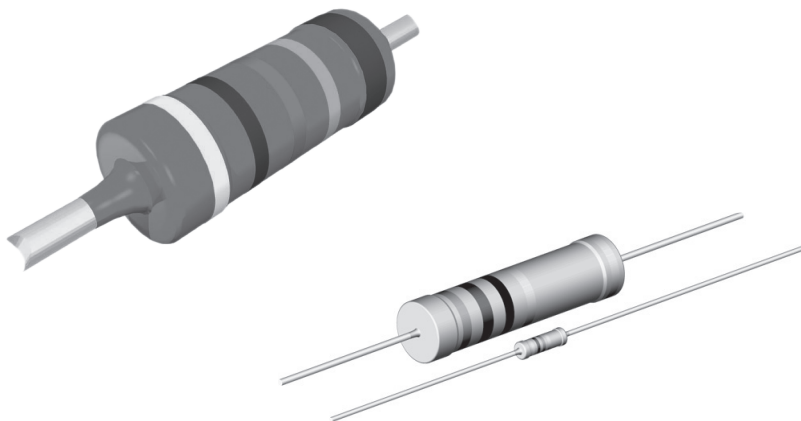
General Purpose



Flameproof Types



Fusible Types



Contents

LCA....	220
LCA....NE	224
HCA0207	228
LCA....SI	230
SKS	232
B, T	236
D, G	238
SPW	240
CBB 0207	242

Carbon Film Resistors, Standard



FEATURES

- Securely bonded carbon film
- Good moisture resistance ($\Delta R_{\max.} \leq \pm 1.5 \% R$)
- Good long term stability ($\Delta R_{\max.} \leq \pm 1.5 \% R$, for 1000 h)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- Low Noise (refer to graph)
- Suitable for general purpose commercial electronics and pulse load applications



STANDARD ELECTRICAL SPECIFICATIONS

MODEL	SIZE	POWER RATING $P_{70\text{ }^{\circ}\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX. V_{\equiv}	TOLERANCE $\pm \%$	RESISTANCE RANGE Ω	E-SERIES
LCA0204	0204	0.25	200	± 2 ± 5	10R - 470K 1R0 - 1M0	24 24
LCA0207	0207	0.35	300	± 2 ± 5	1R0 - 1M0 R22 - 5M1	24 24
LCA0411	0411	0.55	500	± 2 ± 5	1R0 - 1M0 R22 - 10M	24 24
LCA0414	0414	0.6	500	± 2 ± 5	1R0 - 1M0 R22 - 10M	24 24

Notes:

- Coating: Beige
- Marking: Color code

TECHNICAL SPECIFICATIONS

PARAMETER	UNIT	LCA0204	LCA0207	LCA0411	LCA0414
Rated Dissipation at 70 °C	W	0.25	0.35	0.55	0.6
Limiting Element Voltage ⁽¹⁾	V_{\equiv}	≤ 200	≤ 300	≤ 500	≤ 500
Limiting Voltage, Short-Time	V_{\equiv}		500	700	1000
Insulation Voltage (1 Min)	V-	> 300	> 700	> 700	> 700
Thermal Resistance	K/W	≤ 300	≤ 220	≤ 150	≤ 140
Insulation Resistance	Ω	$\geq 10^{11}/h$			
Terminal Strength, Axial	N	> 30	> 50	> 60	> 80
Category Temperature Range	°C	- 55 to + 155			
Failure Rate	$10^{-9}/h$	< 10			
Weight	g	0.1	0.21	0.5	0.68

Note:

⁽¹⁾ Rated voltage $\sqrt{P \times R}$

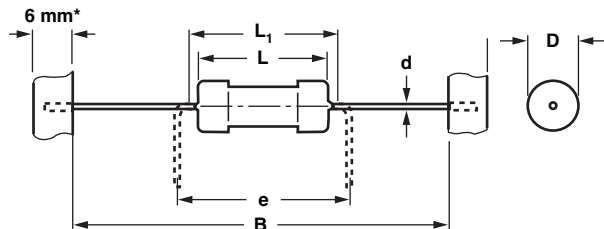
PART NUMBER AND PRODUCT DESCRIPTION WR-SERIES																	
PART NUMBER: LCA0204002401J2500																	
L	C	A	0	2	0	4	0	0	2	4	0	1	J	2	5	0	0
MODEL/SIZE LCA0204 LCA0207 LCA0411 LCA0414	SPECIAL CHARACTER 0 = Neutral	TCR 0 = Neutral See diagram	VALUE 3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 2 = *10 ² 8 = *10 ⁻² 3 = *10 ³ 9 = *10 ⁻¹ 4 = *10 ⁴ 0 = *10 ⁰ 5 = *10 ⁵ 1 = *10 ¹ 6 = *10 ⁶	TOLERANCE G = ± 2 % J = ± 5 %	PACKAGING (1) 12 = A2(G26) 22 = A2(G53) 25 = A5 21 = A1(G53) 41 = A1(G73) D5 = R5 DE = RE F2 = R2	SPECIAL Up to 2 digits 00 = Standard	PRODUCT DESCRIPTION: LCA0204 2K4 5 % A5										
LCA0204	2K4	5 %	A5														
MODEL LCA0204 LCA0207 LCA0411 LCA0414	RESISTANCE VALUE 220K = 220 kΩ 10R = 10 Ω	TOLERANCE ± 2 % ± 5 %	PACKAGING (1) A2 (G26) A1 (G73) A2 (G53) R5 A5 RE A1 (G53) R2														

Notes:

- (1) Please refer to table PACKAGING
- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products

PACKAGING						
MODEL	REEL			BOX		
	PIECES/REEL	CODE	MIN. ORDER QTY PACKAGING UNITS	PIECES/BOX	CODE	MIN. ORDER QTY PACKAGING UNITS
LCA0204	5000	R5	1	5000 2000	A5 A2	1 1
LCA0207	5000	R5	1	5000 2000	A5 A2	1 1
LCA0411	2500	RE	1	1000	A1	1
LCA0414	2000	R2	1	1000	A1	1

DIMENSIONS



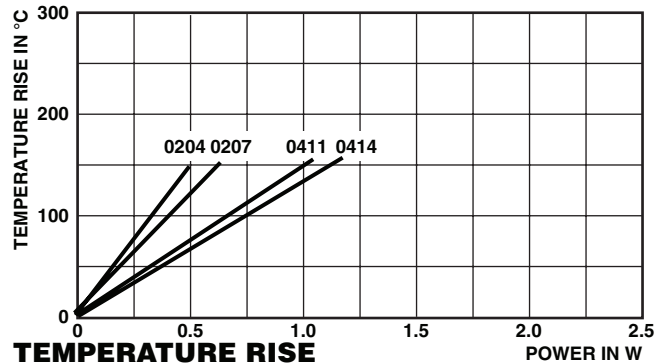
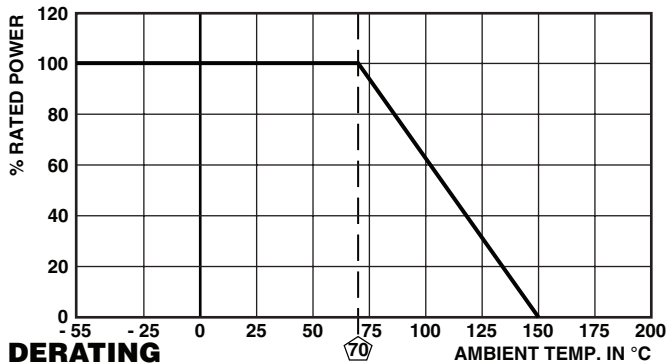
Notes:

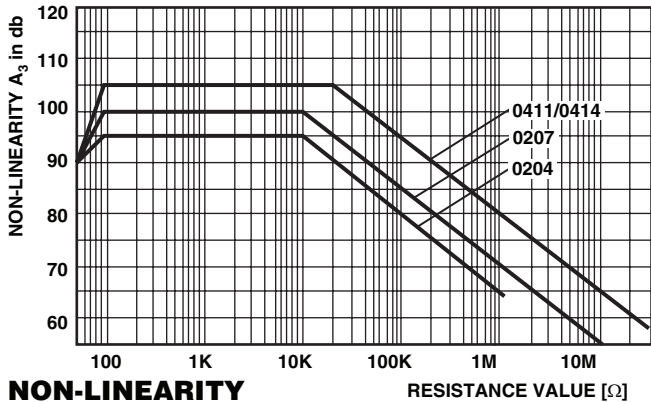
- Taping in acc. with IEC60286-1
- D and L measured in acc. with IEC60294
- d according to IEC60301

MODEL	DIMENSIONS [in millimeters]					
	D _{max.}	L	L ₁	B	d	e
LCA0204	1.6 -0.3	3.6 -0.4	5.0	53 ±1	0.5	5.0
LCA0207	2.4 -0.3	6.1 -0.5	8.1	53 ±1 (1)	0.6	7.5
LCA0411	3.7 -0.4	10.5 -0.6	12.5	53 ±1 (2)	0.7	12.5
LCA0414	4.2 -0.5	12.2 -0.7	14.2	53 ±1 (2)	0.8	15.0

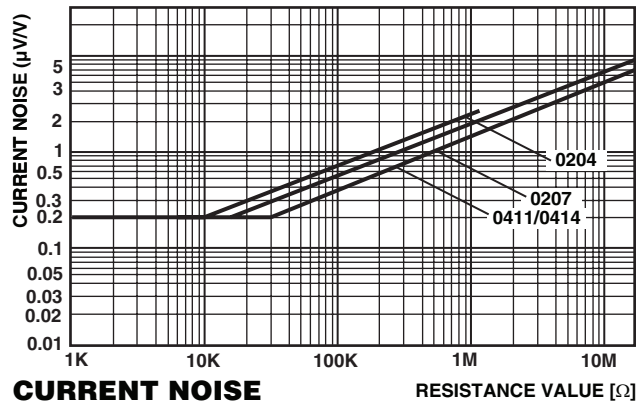
Notes:

- (1) Also available in 26 mm tape spacing
- (2) Also available in 73 mm tape spacing

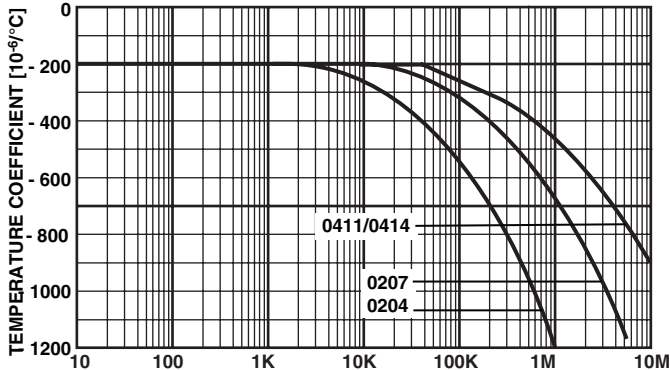




NON-LINEARITY

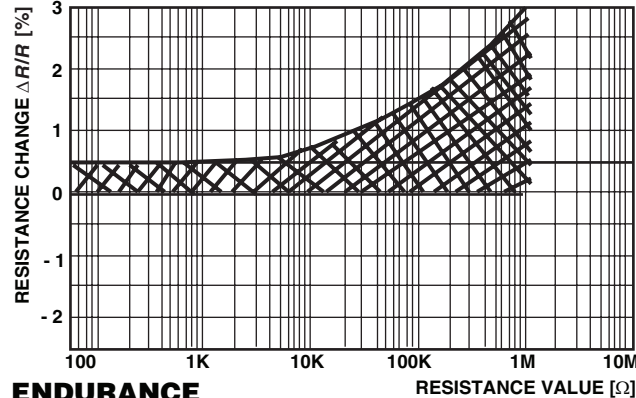


CURRENT NOISE



TEMPERATURE COEFFICIENT

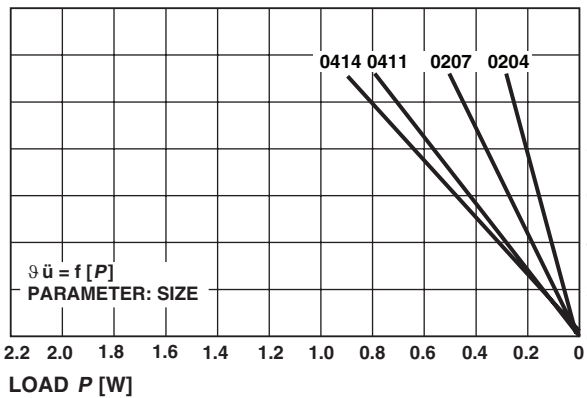
(mean value) between - 25... + 125 °C deviation ± 25 %



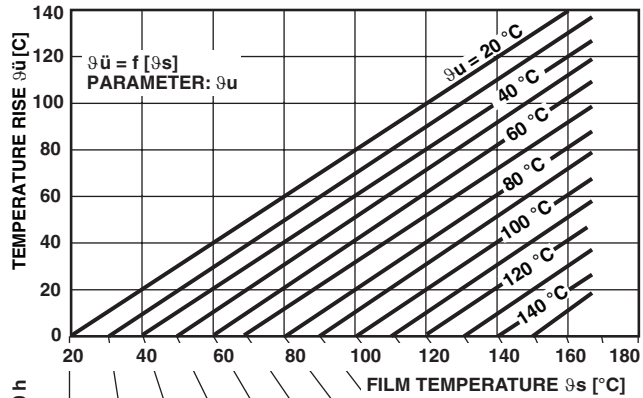
ENDURANCE

at upper category temperature, 155 °C 1000 h

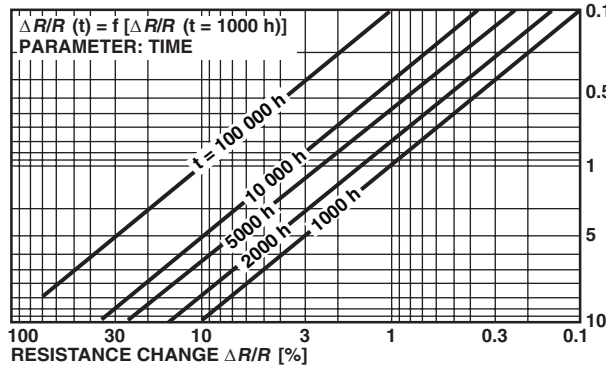
STABILITY NOMOGRAM, TYPICAL VALUES (For handling see General Information)



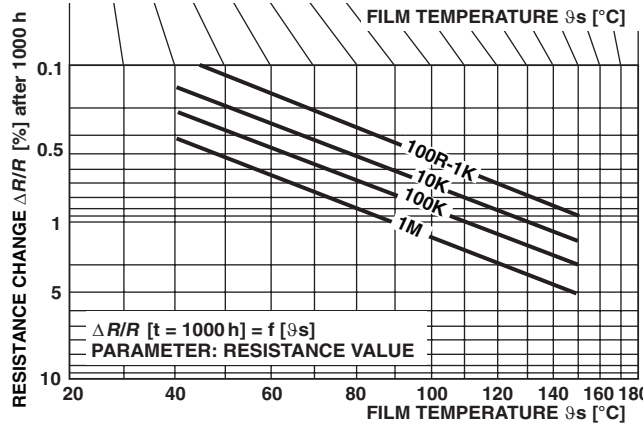
LOAD P [W]



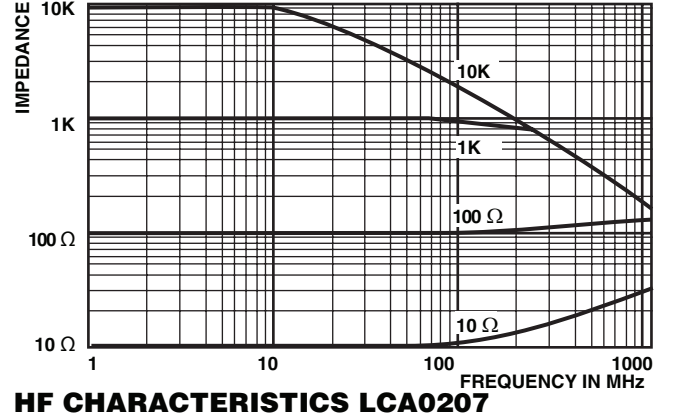
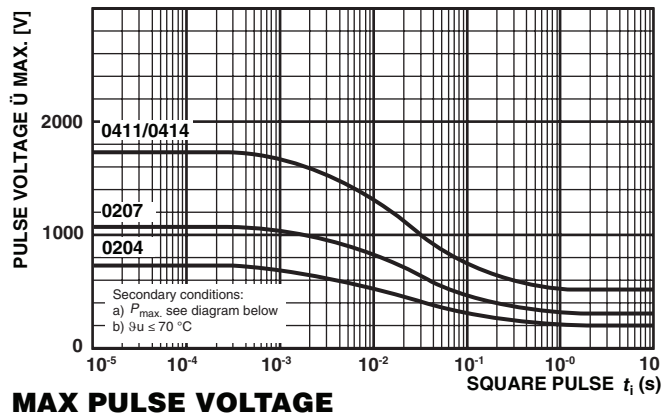
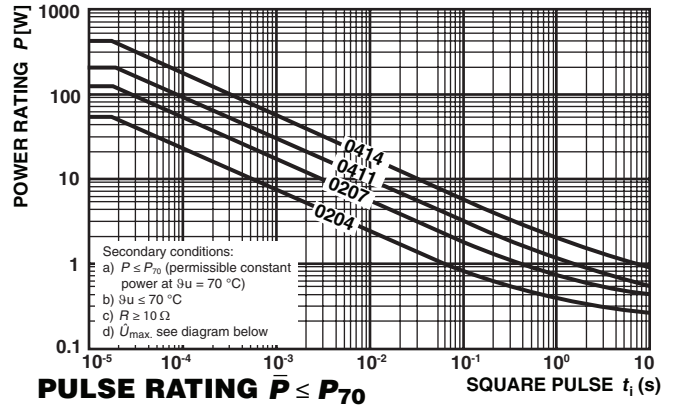
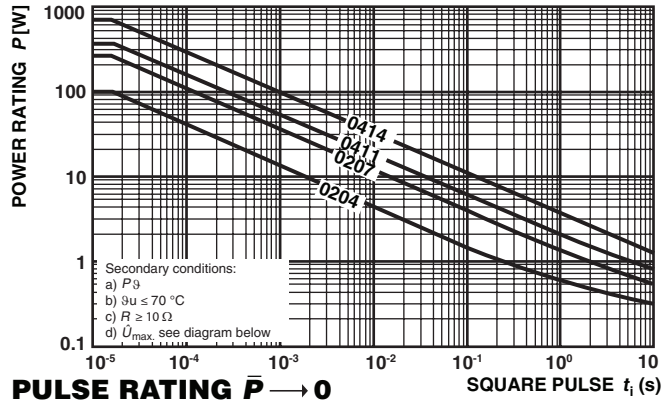
FILM TEMPERATURE θs [°C]



RESISTANCE CHANGE ΔR/R [%]



FILM TEMPERATURE θs [°C]



PERFORMANCE CHARACTERISTICS		
TEST	CONDITIONS OF TEST	REQUIREMENTS (1)
Endurance Test at 70 °C IEC 60115-1 4.25.1	1000 h at 70 °C, 1.5 h ON, 0.5 h OFF 8000 h at 70 °C, 1.5. h ON, 0.5 h OFF	≤ ± 1.5 % ≤ ± 4.0 %
Endurance at UCT IEC 60115-1 4.25.3	1000 h at 155 °C without load 8000 h at 155 °C without load	≤ ± 3.0 % ≤ ± 8.0 %
Overload Test IEC 60115-1 4.13	2.5 x rated power or twice the limiting element voltage, 2 s for sizes ≤ 0207; 5 s for sizes ≥ 0309	≤ ± 0.5 %
Thermal Shock IEC 60115-1 4.19, IEC 60068-2-14	Rapid change between upper and lower category temperature	≤ ± 0.25 %
Climatic Sequence IEC 60115-1 4.23	Dry heat, damp heat cyclic, cold, low air pressure	≤ ± 1.5 %
Damp Heat Steady State IEC 60115 4.24, IEC 60068-2-3	56 days at 40 °C, 93 % relative humidity	≤ ± 1.5 %
Resistance to Soldering Heat IEC 60115-1 4.18, IEC 60068-2-20	10 s at 260 °C solder bath temperature	≤ ± 0.25 %
Robustness of Terminations IEC 60115-1 4.16, IEC 60068-2-21	Tensile, bending and torsion	≤ ± 0.25 %
Vibration IEC 60115-1 4.22, IEC 60068-2-6	0.75 mm or 10 g 10 Hz - 500 Hz 6 h	≤ ± 0.25 %

Note:

(1) For ohmic values between 10 Ω and 1 MΩ

APPLICABLE SPECIFICATIONS
<ul style="list-style-type: none"> • CECC 40000/40100/40101 • EN 140000/140 100

Carbon Film Resistors, Flameproof



FEATURES

- Flameproof coating
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- Suitable for applications with special safety requirements



STANDARD ELECTRICAL SPECIFICATIONS

MODEL	SIZE	POWER RATING $P_{70\text{ }^{\circ}\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX. V_{\equiv}	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
LCA0204NE	0204	0.25	200	± 2 ± 5	10R - 470K 1R0 - 1M	48 24
LCA0207NE	0207	0.35	250	± 2 ± 5	1R0 - 2M2 R22 - 10M	48 24
LCA0411NE	0411	0.5	350	± 2 ± 5	1R0 - 5M1 R22 - 10M	48 24
LCA0414NE	0414	0.55	500	± 2 ± 5	1R0 - 5M1 R22 - 10M	48 24

Notes:

- Coating: Beige
- Marking: Color code, additional gold band at one end

TECHNICAL SPECIFICATIONS

PARAMETER	UNIT	0204	0207	0411	0414
Power Rating at 70 °C	W	0.25	0.35	0.5	0.55
Limiting Element Voltage ⁽¹⁾	V_{\equiv}	< 200	< 250	< 350	< 500
Thermal Resistance	K/W	≤ 300	≤ 220	≤ 150	≤ 140
Terminal Strength, Axial	N	> 30	> 50	> 60	> 80
Category Temperature Range	°C	- 55 to + 155			
Failure Rate	$10^{-9}/h$	< 20			
Weight	g	0.1	0.21	0.5	0.68

Note:

⁽¹⁾ Rated voltage $\sqrt{P \times R}$

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER: LCA0204C02401GD500

L	C	A	0	2	0	4	C	0	2	4	0	1	G	D	5	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MODEL/SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING ⁽¹⁾	SPECIAL
LCA0204 LCA0207 LCA0411 LCA0414	C = NE (Non-flammable)	0 = Neutral See diagram	3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 8 = *10 ⁻² 9 = *10 ⁻¹ 0 = *10 ⁰ 1 = *10 ¹ 2 = *10 ² 3 = *10 ³ 4 = *10 ⁴ 5 = *10 ⁵ 6 = *10 ⁶	G = ± 2 % J = ± 5 %	12 = A2 (G26) 22 = A2 (G53) 25 = A5 21 = A1 (G53) 41 = A1 (G73) D5 = R5 DE = RE F2 = R2	Up to 2 digits 00 = Standard

PRODUCT DESCRIPTION: LCA0204NE 2K4 2% R5

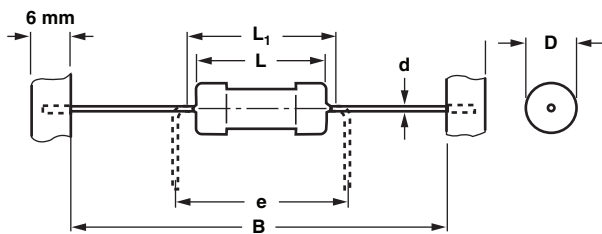
LCA0204NE MODEL LCA0204NE LCA0207NE LCA0411NE LCA0414NE	2K4 RESISTANCE VALUE 220K = 220 kΩ 10R = 10 Ω	2% TOLERANCE ± 2 % ± 5 %	R5 PACKAGING ⁽¹⁾ A2 (G26) A2 (G53) A5 A1 (G53) A1 (G73) R5 RE R2
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Notes:

⁽¹⁾ Please refer to table PACKAGING.

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products.

DIMENSIONS



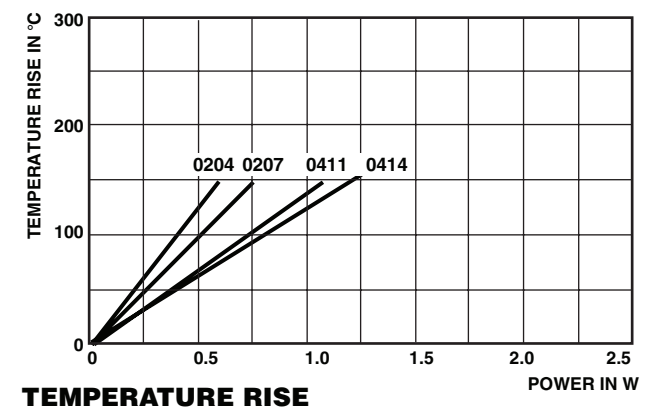
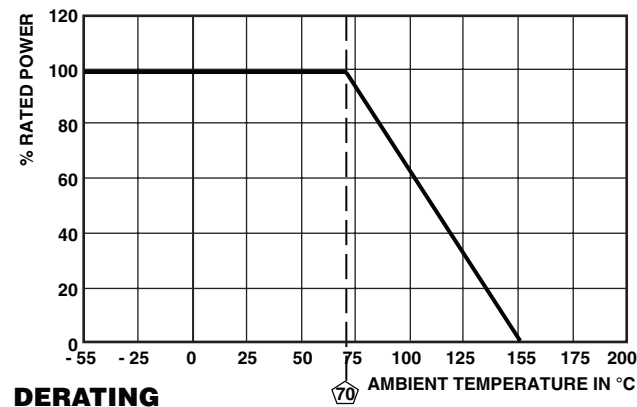
MODEL	DIMENSIONS [in millimeters]					
	D _{max.}	L	L ₁	B	d	e
LCA0204NE	1.6 -0.3	3.6 -0.4	4.0	53 ± 1 ⁽²⁾	0.5	5.0
LCA0207NE	2.3 -0.3	6.1 -0.5	8.1	53 ± 1 ⁽²⁾	0.6	7.5
LCA0411NE	3.5 -0.3	10.5 -0.6	12.5	53 ± 1 ⁽³⁾	0.7	12.5
LCA0414NE	3.8 -0.3	12.2 -0.7	14.2	53 ± 1 ⁽³⁾	0.8	15.0

Notes:

- Taping in acc. with IEC60286-1
- D and L measured in acc. with IEC60294
- d according to IEC60301

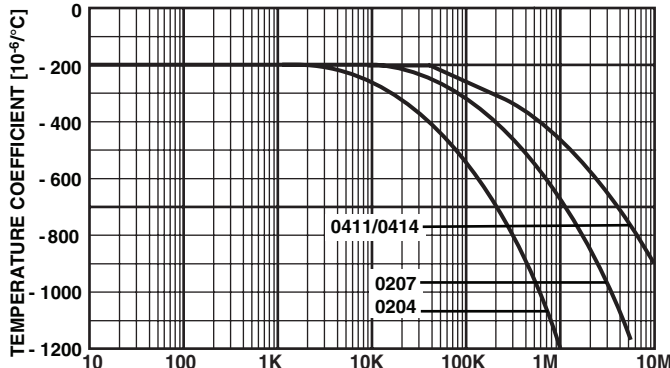
Notes:

- ⁽²⁾ Also available in 26 mm tape spacing
- ⁽³⁾ Also available in 73 mm spacing

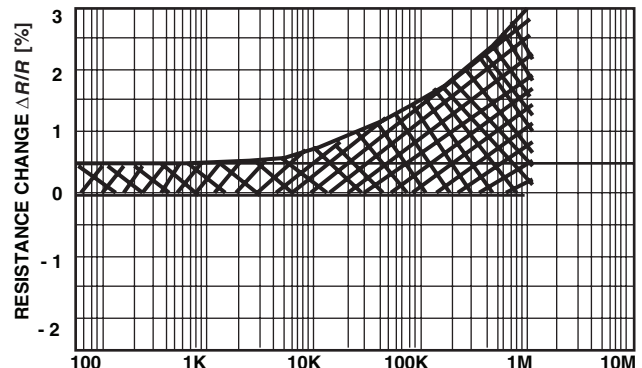




PACKAGING						
MODEL	REEL			BOX		
	PIECES/REEL	CODE	MIN. ORDER QTY PACKAGING UNITS	PIECES/BOX	CODE	MIN. ORDER QTY PACKAGING UNITS
LCA0204NE	5000	R5	1	5000/2000	A5/A2	1
LCA0207NE	5000	R5	1	5000/2000	A5/A2	1
LCA0411NE	2500	RE	1	1000	A1	1
LCA0414NE	2000	R2	1	1000	A1	1

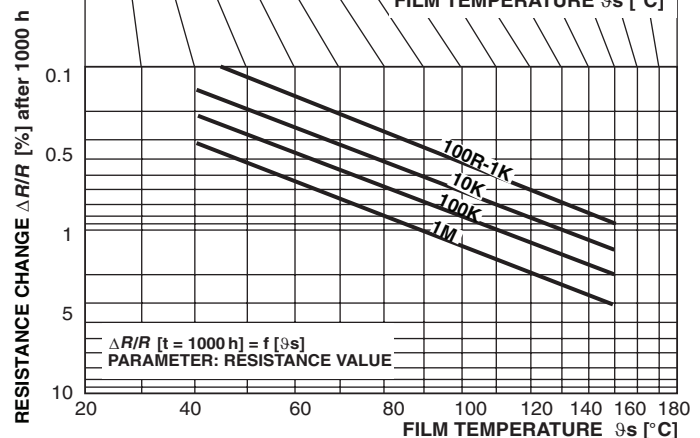
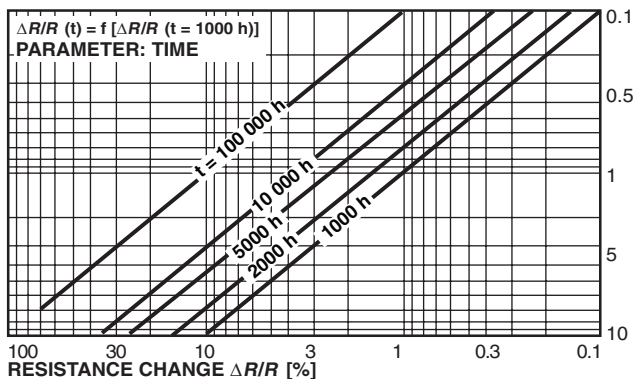
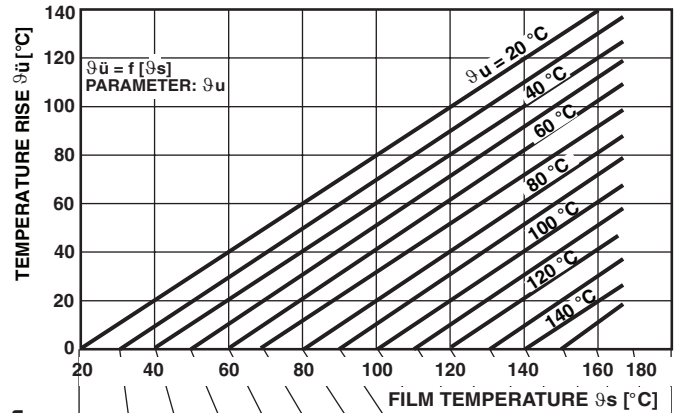
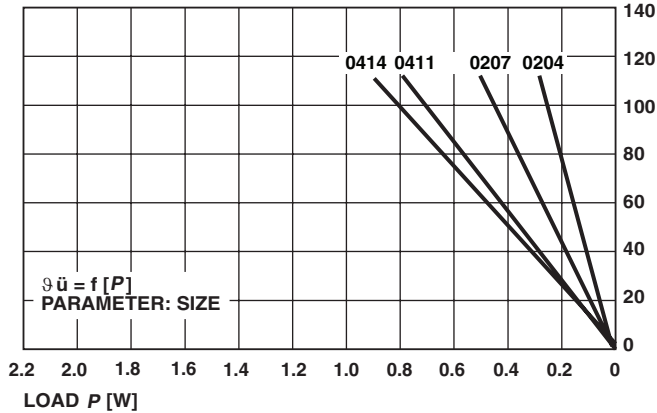


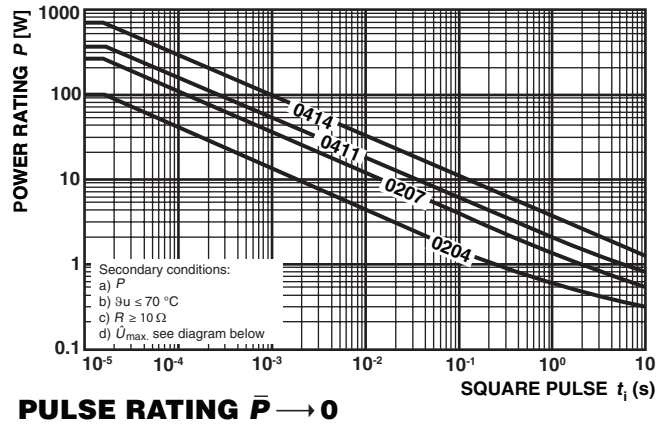
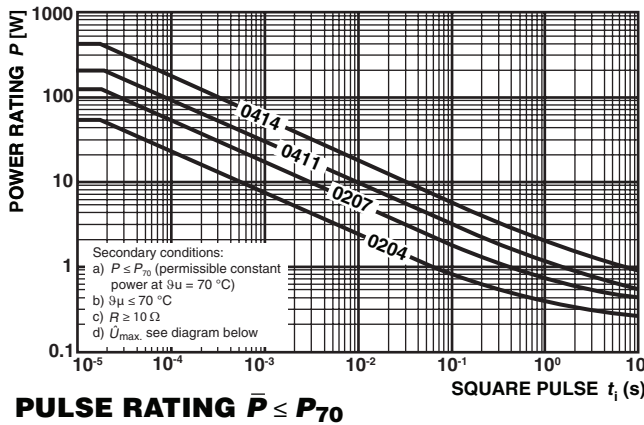
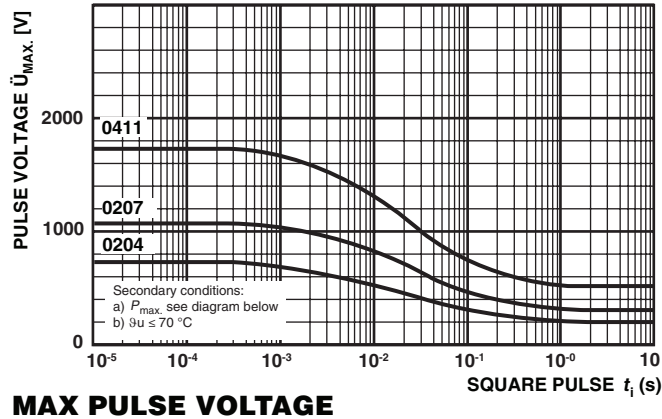
TEMPERATURE COEFFICIENT
(mean value) between - 25... + 125 °C deviation ± 25 %



ENDURANCE
at upper category temperature, 155 °C 1000 h

STABILITY NOMOGRAM, TYPICAL VALUES (For handling see General Information)



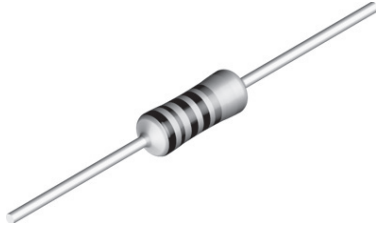


PERFORMANCE		
TEST	CONDITIONS OF TEST	REQUIREMENTS (1)
Endurance at 70 °C IEC 60115-1 4.25.1	1000 h at 70 °C, 1.5 h ON, 0.5 h OFF 8000 h at 70 °C, 1.5 h ON, 0.5 h OFF	$\leq \pm 1.5 \%$ $\leq \pm 4.0 \%$
Endurance at UCT IEC 60115-1 4.25.3	1000 h at 155 °C, without load 8000 h at 155 °C, without load	$\leq \pm 3.0 \%$ $\leq \pm 8.0 \%$
Overload Test IEC 60115-1 4.13	2.5 x rated power or twice the limiting element voltage, 2 s size ≤ 0207 ; 5 s for sizes ≥ 0309	$\leq \pm 0.5 \%$
Thermal Shock IEC 60115-1 4.19, IEC 60068-2-14	Rapid change between upper and lower category temperature	$\leq \pm 0.25 \%$
Climatic Sequence IEC 60115-1 4.23	Dry heat, damp heat cyclic, cold, low air pressure	$\leq \pm 1.5 \%$
Damp Heat Steady State IEC 60115-1 4.24 IEC 60068-2-3	56 days at 40 °C, 93 % relative humidity	$\leq \pm 1.5 \%$
Resistance to Soldering Heat IEC 60115-1 4.18, IEC 60068-2-20	10 s at 260 °C solder bath temperature	$\leq \pm 0.25 \%$
Robustness of Terminations IEC 60115-1 4.16, IEC 60068-2-21	Tensile, bending and torsion	$\leq \pm 0.25 \%$
Vibration IEC 60115-1 4.22, IEC 60068-2-6	0.75 mm or 10 g 10 Hz - 500 Hz 6 h	$\leq \pm 0.25 \%$

Note:

(1) For ohmic values between 10 Ω and 1 M Ω

Carbon Film Resistors, Power Type



FEATURES

- Carbon film resistor with high power rating
- Stable film structure on special ceramic
- Good overload and pulse withstanding characteristics
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- For applications in power electronics and general purpose commercial electronics



STANDARD ELECTRICAL SPECIFICATIONS						
MODEL	POWER RATING $P_{70^\circ\text{C}}$ W	LIMITING ELEMENT VOLTAGE MAX. V_{\equiv}	TEMP. COEF. ppm/K	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
HCA0207	0.8	500	- 220 to - 1500	± 1	10R - 1M0	48
				± 2	4R7 - 2M2	48
				± 5	4R7 - 2M2	24

Notes:

- Coating: Green
- Marking see appropriate catalog or web page
- Additional yellow dot at the beginning of the code.

TECHNICAL SPECIFICATIONS		
PARAMETER	UNIT	HCA0207
Rated Dissipation at 70 °C	W	0.8
Limiting Element Voltage ⁽¹⁾	V_{\equiv}	≤ 500
Max. Pulse Voltage	V_{\equiv}	1050
Insulation Voltage (1 Min)	V_{eff}	≥ 700
Thermal Resistance	K/W	130
Insulation Resistance	Ω	$\geq 10^{10}$
Category Temperature Range	$^\circ\text{C}$	- 55 to ± 175
Failure Rate	$10^{-9}/\text{h}$	< 20
Terminal Strength, Axial	N	> 50
Weight	g	0.22

Note:

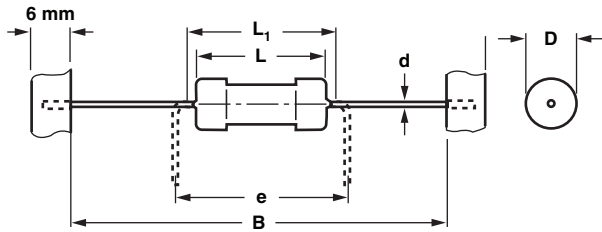
⁽¹⁾ Rated voltage $\sqrt{P \times R}$

PART NUMBER AND PRODUCT DESCRIPTION																									
PART NUMBER: HCA0207001000G25																									
<table border="0" style="width:100%; text-align:center;"> <tr> <td>H</td><td>C</td><td>A</td><td>0</td><td>2</td><td>0</td><td>7</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>G</td><td>2</td><td>5</td><td></td><td></td> </tr> </table>								H	C	A	0	2	0	7	0	0	1	0	0	0	G	2	5		
H	C	A	0	2	0	7	0	0	1	0	0	0	G	2	5										
MODEL	SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING ⁽²⁾	SPECIAL																		
HCA	0207	0 = Neutral	0 = Neutral See datasheet for TCR value	3 digit value 1 digit multiplier MULTIPLIER 7 = $\ast 10^{-3}$ 2 = $\ast 10^2$ 8 = $\ast 10^{-2}$ 3 = $\ast 10^3$ 9 = $\ast 10^{-1}$ 4 = $\ast 10^4$ 0 = $\ast 10^0$ 5 = $\ast 10^5$ 1 = $\ast 10^1$ 6 = $\ast 10^6$	F = $\pm 1\%$ G = $\pm 2\%$ J = $\pm 5\%$	22 = A2 25 = A5 D5 = R5	Up to 2 digits 00 = Standard																		
PRODUCT DESCRIPTION: HCA0207 - 100R 2 % A5																									
HCA0207	-	-	100R	2 %	A5																				
MODEL	TCR	RESISTANCE VALUE	TOLERANCE	PACKAGING ⁽²⁾																					
HCA0207	-	49K9 = 49.9 k Ω 50R1 = 50.1 Ω	$\pm 1\%$ $\pm 2\%$ $\pm 5\%$	A2 A5 R5																					

Notes:

- ⁽²⁾ Please refer to table PACKAGING, see next page
- Products can be ordered using either the PRODUCT DESCRIPTION or the PART NUMBER

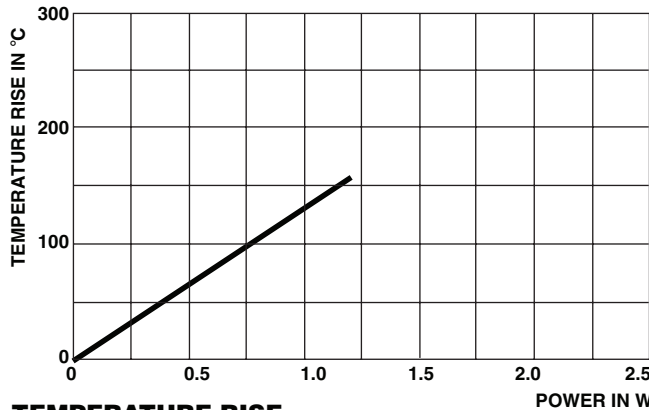
DIMENSIONS



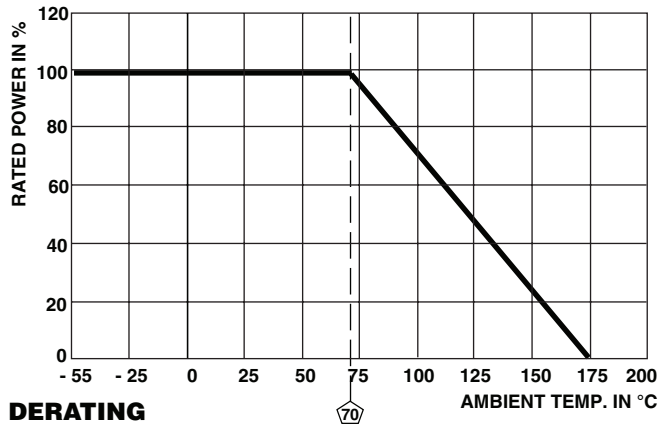
MODEL	DIMENSIONS [in millimeters]					
	D _{max.}	L	L _{1 max.}	B	d	e
HCA0207	2.5 - 0.3	6.3 - 0.5	7.5	53 ± 1	0.6	7.5

Notes:

- Taping in acc. with IEC60286-1
- D and L measured in acc. with IEC60294
- d according to IEC60301



TEMPERATURE RISE



DERATING

PACKAGING						
MODEL	REEL			BOX		
	PIECES/REEL	CODE	MIN. ORDER QUANTITY PACKING UNITS	PIECES/BOX	CODE	MIN. ORDER QUANTITY PACKING UNITS
HCA0207	5000	R5	1	5000	A5	1
				2000	A2	2

PERFORMANCE		
TEST	CONDITIONS OF TEST	REQUIREMENTS (1)
Endurance 1000 hours at 70 °C IEC 60115-1 4.25.1	1000 h at 70 °C, 1.5 h ON, 0.5 h OFF	≤ ± 2.0 %
Endurance at UCT IEC 60115-1 4.25.3	1000 h at 155 °C without load	≤ ± 5.0 %
Overload Test IEC 60115-1 4.13	Short time overload 5 s at 2.5 x rated voltage or ≤ twice the limiting element voltage	≤ ± 0.5 %
Thermal Shock IEC 60115-1 4.19, IEC 60068-2-14	Rapid change between upper and lower category temperature	≤ 0.25 %
Climatic Sequence IEC 60115-1 4.23	Dry heat, damp heat cyclic, cold, low air pressure	≤ 2.0 %
Dampe Heat Steady State IEC 60115-1 4.24, IEC 60068-2-3	56 days at 40 °C and 93 % relative humidity	≤ 2.0 %
Resistance to Soldering Heat IEC 60115-1 4.18, IEC 60068-2-20	10 s at 260 °C solder bath temperature	≤ ± 0.25 %
Robustness of Terminations IEC 60115-1 4.16, IEC 60068-2-21	Tensile, bending and torsion	≤ ± 0.25 %
Vibration IEC 60115-1 4.22	0.75 mm or 10 g, 10 Hz - 500 Hz 6 h	≤ ± 0.25 %

Note:

(1) For a resistance range of 10 R to 1M0

APPLICABLE SPECIFICATIONS
• CECC 40000/40100/40101

Carbon Film Resistors, Fusible Type



FEATURES

- Fusible resistor for constant voltage
- Specially spiralled to provide the fusible function
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- Flame-proof protection



STANDARD ELECTRICAL SPECIFICATIONS					
MODEL	POWER RATING $P_{70\text{ }^\circ\text{C}}$ W	TEMPERATURE COEFFICIENT ppm/K	TOLERANCE %	RESISTANCE RANGE Ω	E-SERIES
LCA0207SI	0.25	+ 300/- 200	± 5	R22 - 1K0	24
LCA0411SI	0.35	+ 300/- 200	± 5	R22 - 1K0	24

Notes:

- Coating: Beige
- Marking: Additional 5th band yellow, see appropriate catalog or web page
- $R_i \geq 6 \Omega$ for $R_N < 10R$
- $R_i \geq 1 \Omega$ for $R_N \geq 10R$

TECHNICAL SPECIFICATIONS				
PARAMETER	UNIT	LCA0207SI	LCA0411SI	
Power Rating at 70 °C	W	0.25	0.35	
Overload to Fuse	W	4 ⁽¹⁾	7.0	
Time to Fuse (Maximum)	s	15	25	
Thermal Resistance	K/W	≤ 220	≤ 150	
Terminal Strength, Axial	N	≥ 50	≥ 60	
Failure Rate	$10^{-9}/h$	< 30	< 30	
Category Temperature Range	°C	- 55 to + 125	- 55 to + 125	
Weight	g	0.21	0.5	
Maximum Applicable Voltage After Fusing	$< 1 \Omega$	20	30	
	$> 1 \Omega \dots 10 \Omega$	65	85	
	$> 10 \Omega \dots 100 \Omega$	110	140	
	$> 100 \Omega \dots 1K$	150	200	

Note:

(1) Overload to fuse $< 1 \Omega$ 5 W

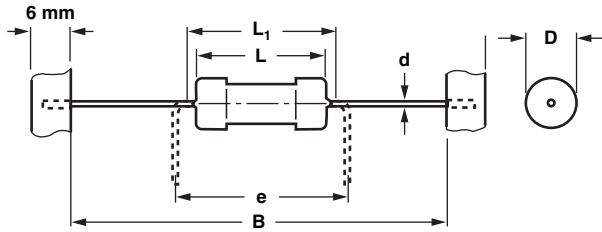
PART NUMBER AND PRODUCT DESCRIPTION																	
PART NUMBER: LCA0411B03609J2100																	
L	C	A	0	4	1	1	B	0	3	6	0	9	J	2	1	0	0
MODEL/SIZE LCA0207 LCA0411	SPECIAL CHARACTER B = SI Fusible	TCR 0 = Neutral See diagram	VALUE 3 digit value 1 digit multiplier MULTIPLIER 7 = $\cdot 10^{-3}$ 8 = $\cdot 10^{-2}$ 9 = $\cdot 10^{-1}$ 0 = $\cdot 10^0$ 1 = $\cdot 10^1$	TOLERANCE J = $\pm 5\%$	PACKAGING ⁽²⁾ D5 = R5 DE = RE 21 = A1(G53) 41 = A1(G73) 12 = A2(G26) 22 = A2(G53) 25 = A5	SPECIAL Up to 2 digits 00 = Standard											
PRODUCT DESCRIPTION: LCA0411SI 36R 5% A1																	
LCA0411SI	MODEL	36R	RESISTANCE VALUE	5%	TOLERANCE	A1	PACKAGING ⁽²⁾										
LCA0207SI LCA0411SI		1K0 = 1 k Ω 10R = 10 Ω		$\pm 5\%$		R5 RE A1 (G53) A1 (G73) A2 (G26) A2 (G53) A5											

Notes:

(2) Please refer to table PACKAGING, see next page

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products

DIMENSIONS



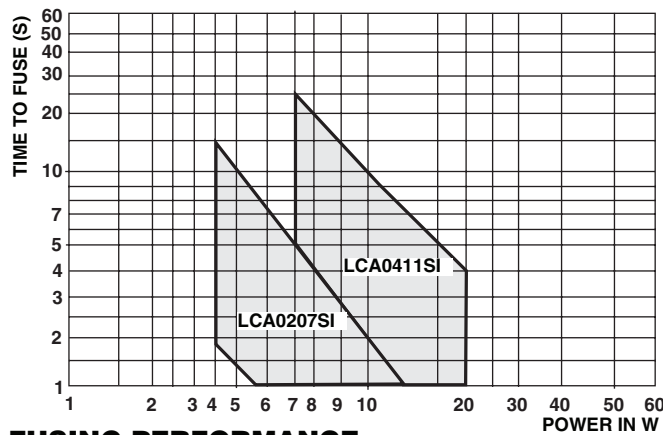
Notes:

- Taping in acc. with IEC60286-1
- D and L measured in accordance with IEC60294
- d according to IEC60301

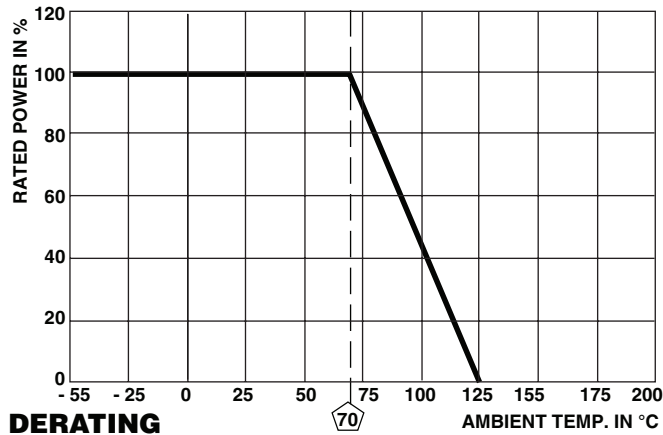
MODEL	DIMENSIONS [in millimeters]					
	D	L	L ₁ max.	B	d	e
LCA0207SI	2.3 - 0.3	6.1 - 0.5	8.1	53 ± 1 ⁽¹⁾	0.6	7.5
LCA0411SI	3.5 - 0.3	10.5 - 0.6	12.5	53 ± 1 ⁽²⁾	0.7	12.5

Notes:

- ⁽¹⁾ Also available in 26 mm tape spacing
- ⁽²⁾ Also available in 73 mm spacing



FUSING PERFORMANCE



DERATING

PACKAGING						
MODEL	PIECES/ REEL	CODE	MIN. ORDER QTY PACKAGING UNITS	PIECES/ BOX	CODE	MIN. ORDER QTY PACKAGING UNITS
LCA0207SI	5000	R5	1	2000/5000	A2/A5	2/1
LCA0411SI	2500	RE	1	1000	A1	2

Note:

- For further information about packaging see appropriate catalog or web page

Carbon Film Resistors, Fusible Type



FEATURES

- Fusible resistor for constant voltage designed for over load protection
- Special construction opens the resistor at a specified overload
- Non inflammable coating
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- Defined switch-off behaviour



STANDARD ELECTRICAL SPECIFICATIONS

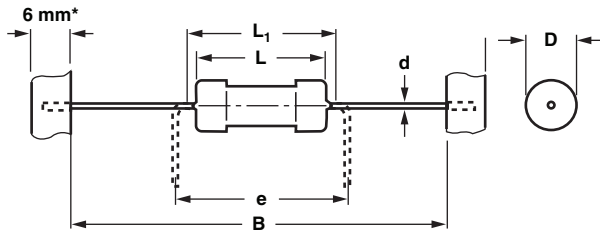
MODEL	SIZE	POWER RATING $P_{70\text{ }^{\circ}\text{C}}$ W	TOLERANCE %	RESISTANCE RANGE Ω
SKS2	0207	0.30	$\pm 5, \pm 10$	1R0 - 5K1
SKS4	0414	0.50	$\pm 5, \pm 10$	1R0 - 5K1

Notes:

- $R_i \geq 6 \Omega$ for $R_N < 10R$
- $R_i \geq 1 \Omega$ for $R_N \geq 10R$
- Coating: Red brown
- Marking: 5th band yellow

TECHNICAL SPECIFICATIONS

PARAMETER	UNIT	SKS2	SKS4
Rated Dissipation at 70 °C	W	0.30	0.50
Overload to Fuse	W	3.5	7.0
Time to Fuse (Max.)	s	40	70
Max. Permissible Voltage	V	See diagram	
Voltage Coefficient	1/V	$< 10^{-7}$	$< 10^{-7}$
Current Noise	$\mu\text{V/V}$	< 0.1	< 0.1
Thermal Resistance (Max.)	K/W	220	130
Thermal Time Constant	s	8	20
Category Temperature Range	$^{\circ}\text{C}$	- 55 to + 125	
Failure Rate	$10^{-9}/\text{h}$	< 30	
Weight	g	0.2	0.7

DIMENSIONS


MODEL	DIMENSIONS [in millimeters]					
	D	L	L ₁ max.	B	d	e
SKS2	2.5 - 0.5	6.0 - 0.5	7.5	53 ± 1	0.6	7.5
SKS4	4.1 - 0.5	12.0 - 1.5	15.0	73 ± 1	0.8	15

Notes:

- Taping in accordance with IEC60286-1
- D and L measured in accordance with IEC60294
- d according to IEC60301

PART NUMBER AND PRODUCT DESCRIPTION
PART NUMBER: SKS2207001000JD500

S	K	S	2	2	0	7	0	0	1	0	0	0	J	D	5	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MODEL/SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING ⁽²⁾	SPECIAL
SKS2207 SKS4414	0 = Neutral	0 = Neutral See diagram	3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 8 = *10 ⁻² 9 = *10 ⁻¹ 0 = *10 ⁰ 1 = *10 ¹	J = ± 5 % K = ± 10 %	D5 = R5 (G53) DE = RE 41 = A1 (G73) 22 = A2 (G53)	Up to 2 digits 00 = Standard

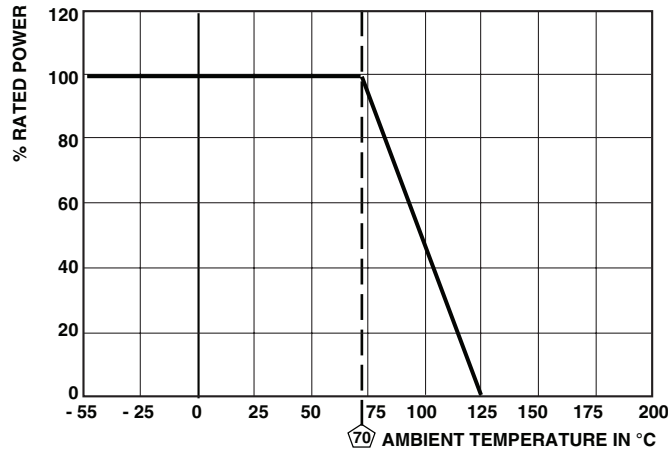
PRODUCT DESCRIPTION: SKS2 100R 5 % R5

<table border="1" style="width: 100%;"> <tr><td style="text-align: center;">SKS2</td></tr> <tr><td style="text-align: center;">MODEL</td></tr> <tr><td style="text-align: center;">SKS2 SKS4</td></tr> </table>	SKS2	MODEL	SKS2 SKS4	<table border="1" style="width: 100%;"> <tr><td style="text-align: center;">100R</td></tr> <tr><td style="text-align: center;">RESISTANCE VALUE</td></tr> <tr><td style="text-align: center;">1K0 = 1 kΩ 10R = 10 Ω</td></tr> </table>	100R	RESISTANCE VALUE	1K0 = 1 kΩ 10R = 10 Ω	<table border="1" style="width: 100%;"> <tr><td style="text-align: center;">5 %</td></tr> <tr><td style="text-align: center;">TOLERANCE</td></tr> <tr><td style="text-align: center;">± 5 % ± 10 %</td></tr> </table>	5 %	TOLERANCE	± 5 % ± 10 %	<table border="1" style="width: 100%;"> <tr><td style="text-align: center;">R5</td></tr> <tr><td style="text-align: center;">PACKAGING ⁽²⁾</td></tr> <tr><td style="text-align: center;">R5 (G53) RE A1 (G73) A2 (G53)</td></tr> </table>	R5	PACKAGING ⁽²⁾	R5 (G53) RE A1 (G73) A2 (G53)
SKS2															
MODEL															
SKS2 SKS4															
100R															
RESISTANCE VALUE															
1K0 = 1 kΩ 10R = 10 Ω															
5 %															
TOLERANCE															
± 5 % ± 10 %															
R5															
PACKAGING ⁽²⁾															
R5 (G53) RE A1 (G73) A2 (G53)															

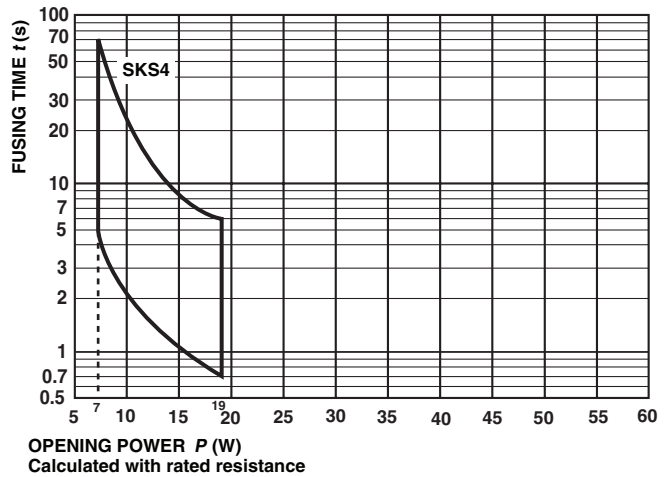
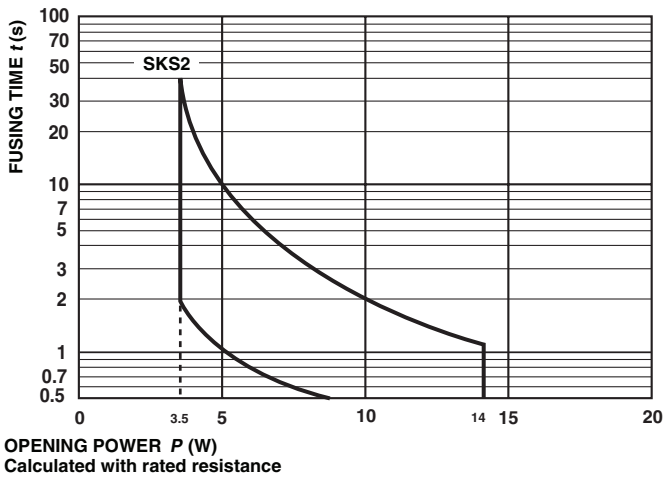
Notes:
⁽²⁾ Please refer to table PACKAGING, see next page

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products

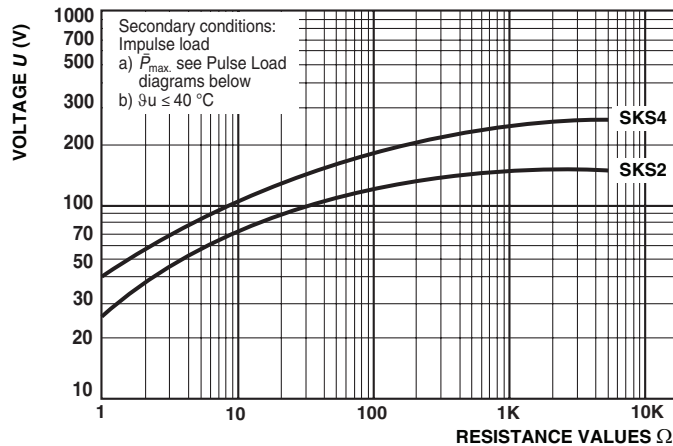
DERATING

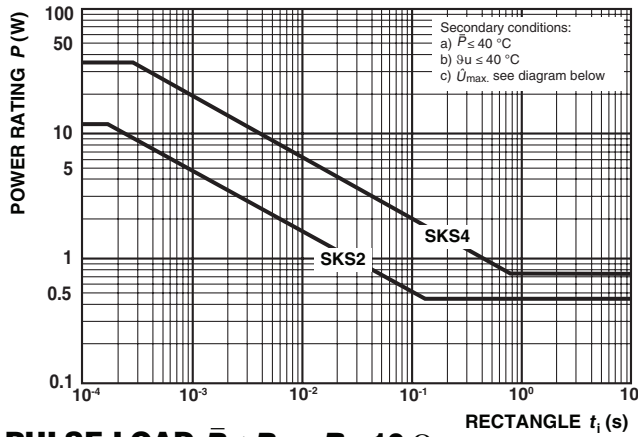


FUSING TIME (AT U = CONSTANT)

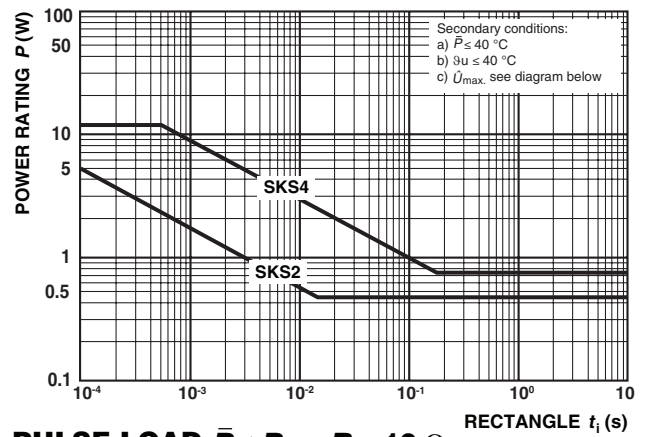


APPROXIMATE VALUES FOR \hat{U}_{MAX} IN CASE OF FAILURE AND MAX. PULSE VOLTAGE

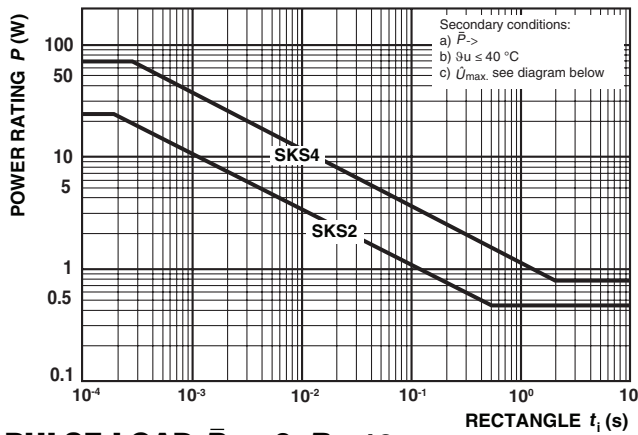




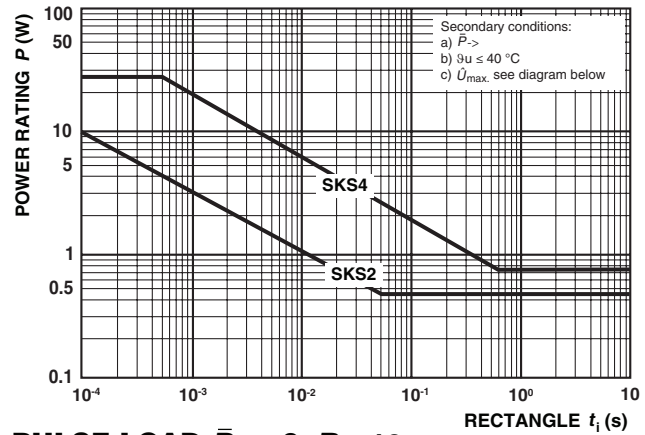
PULSE LOAD $\bar{P} \leq P_{40}$ $R \geq 10 \Omega$



PULSE LOAD $\bar{P} \leq P_{40}$ $R < 10 \Omega$



PULSE LOAD $\bar{P} \rightarrow 0$ $R \geq 10 \Omega$



PULSE LOAD $\bar{P} \rightarrow 0$ $R < 10 \Omega$

PACKAGING

MODEL	REEL		BOX	
	PIECES/REEL	CODE	PIECES/BOX	CODE
SKS2	5000	R5	2000	A2
SKS4	2500	RE	1000	A1

PERFORMANCE

TEST	CONDITIONS	RESULTS
Voltage Coefficient	1/V	$< 10^{-7}$
Ohmic Value after Fusing	Ω	$> 10 \times R_N$
Temperature Coefficient	$10^{-6}/K$	$R < 10 \Omega: +200; R \geq 10 \Omega: -300.. -500$
Non-Linearity	dB	SKS2, SKS4 = 100
Damp Heat Steady State	56 days, 40 °C, (90 - 95) % humidity	$\leq 1 \%$

Carbon Film Resistors, General Purpose, High Voltage



FEATURES

- Ratings to 10 W, 40 kV
- Available with either radial lugs or axial leads
- Epoxy/enamel coated, with additional Mylar® heat shrink sleeve 0.002" [0.051 mm] thick
- ± 20 % tolerance standard, tolerances of ± 15 %, ± 10 % and ± 5 % available
- See models D and G for special purpose high voltage carbon film resistors

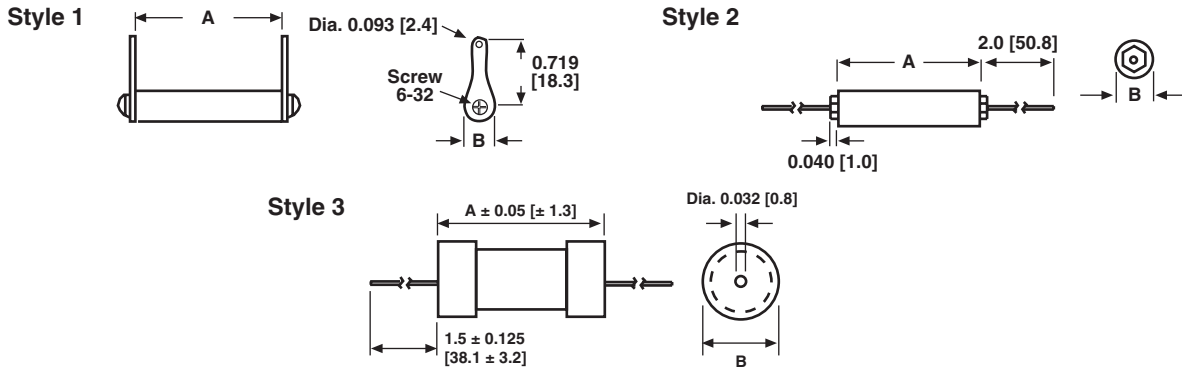
STANDARD ELECTRICAL SPECIFICATIONS					
GLOBAL MODEL	POWER RATING $P_{25\text{ }^\circ\text{C}}$ W	VOLTAGE RATING	RESISTANCE Ω		STYLE
			MIN	MAX	
BAEW	0.5	2.5 kV	50K	500M	2
BAKW	1	5 kV	100K	500M	2
BBF	1	3.5 kV	50K	500M	1
BBFW	1	3.5 kV	50K	500M	2
BBM	2	7.5 kV	50K	500M	1
BBMW	2	7.5 kV	50K	500M	2
BBR	3	15 kV	100K	500M	1
BBRW	3	15 kV	100K	500M	2
BBV	5	30 kV	200K	500M	1
BFQ	4	15 kV	100K	500M	1
BFT	6	25 kV	200K	500M	1
BFW	10	40 kV	400K	500M	1
TAKW	1.5	7.5 kV	1M	500M	3

Note:

- Standard resistance tolerance is ± 20 %. Tolerances of ± 15 %, ± 10 % and ± 5 % are available. All resistance values are calibrated at 100 VDC. Calibration at other voltages available upon request. Contact factory for availability of values outside the listed range.

GLOBAL PART NUMBER INFORMATION				
New Global Part Numbering: BAEW2M50LF08 (preferred part numbering format)				
B	A	E	W	2 M 5 0 L F 0 8
GLOBAL MODEL (3 or 4 digits) (see Standard Electrical Specifications table)	RESISTANCE VALUE K = Thousand M = Million 50K0 = 50 k Ω 1M00 = 1.0 M Ω 500M = 500 M Ω	TOLERANCE CODE J = ± 5 % K = ± 10 % L = ± 15 % M = ± 20 %	PACKAGING COEFFICIENT E08 = Lead (Pb)-free, Foam F08 = Tin/Lead, Foam	SPECIAL Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable
Historical Part Number example: BAEW2M5015% (will continue to be accepted)				
BAEW	2M50	15 %	F08	
HISTORICAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING	

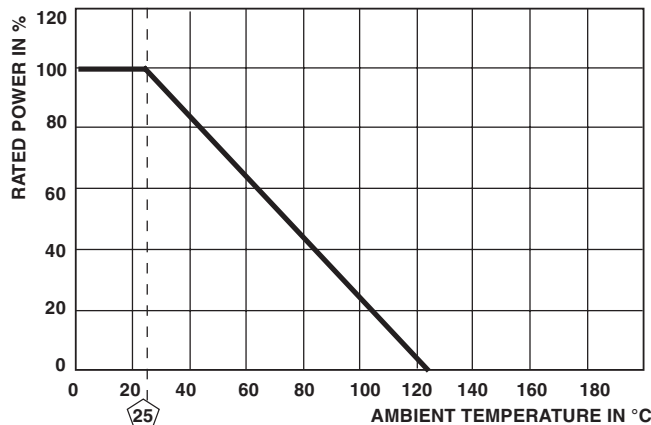
DIMENSIONS in inches [millimeters]



GLOBAL MODEL	STYLE	A	B
BAEW	2	0.75 [19.05]	0.250 [6.35]
BAKW	2	1.50 [38.10]	0.250 [6.35]
BBF	1	1.00 [25.40]	0.313 [7.95]
BBFW	2	1.00 [25.40]	0.313 [7.95]
BBM	1	1.75 [44.45]	0.313 [7.95]
BBMW	2	1.75 [44.45]	0.313 [7.95]
BBR	1	3.00 [76.20]	0.313 [7.95]
BBRW	2	3.00 [76.20]	0.313 [7.95]
BBV	1	5.50 [139.70]	0.313 [7.95]
BFQ	1	2.50 [63.50]	0.563 [14.30]
BFT	1	4.00 [101.60]	0.563 [14.30]
BFW	1	6.50 [165.10]	0.563 [14.30]
TAKW	3	1.55 [39.40]	0.275 ± 0.020 [7.00 ± 0.50]

Note:

- Models B axial leads are #20 AWG tinned copper. All other Dimensional tolerances for styles 1, 2, and 3, unless otherwise specified are ± 0.016" [0.406 mm] for ± 1 %, whichever is greater.



DERATING

MARKING	
	- DALE - Model - Value - Tolerance - Date code

Carbon Film Resistors, Special Purpose, High Voltage



FEATURES

- Ratings to 100 W, 125 kV
- Available with either radial bands or ferrule terminals
- Standard models epoxy/enamel coated, additional vinyl heat shrink sleeve available for added protection
- Model G is non-inductive
- $\pm 20\%$ tolerance standard, tolerances of $\pm 15\%$, $\pm 10\%$ and $\pm 5\%$ available
- See Models B and T for General Purpose High Voltage Carbon Film Resistors

STANDARD ELECTRICAL SPECIFICATIONS

GLOBAL MODEL	HISTORICAL MODEL	POWER RATING $P_{70^\circ\text{C}}$ W	VOLTAGE RATING	RESISTANCE Ω		STYLE	
				MINIMUM	MAXIMUM		
DJU	DJU	10	25 kV	50K	500M	3	
DPW	DPW	20	35 kV	100K	500M	3	
DPW..1	DPW-1	20	35 kV	100K	500M	4	
DPX	DPX	30	65 kV	100K	500M	3	
DPX..1	DPX-1	30	65 kV	100K	500M	4	
DVY	DVY	60	90 kV	400K	500M	3	
DVY..1	DVY-1	60	90 kV	400K	500M	4	
DZW	DZW	35	40 kV	300K	500M	3	
DZW..1	DZW-1	35	40 kV	300K	500M	4	
DZZ	DZZ	100	125 kV	700K	500M	3	
DZZ..1	DZZ-1	100	125 kV	700K	500M	4	
Non-Inductive	GJU	GJU	10	16 kV	1K	1M	3
	GPW	GPW	20	18 kV	1K	1M	3
	GPW..1	GPW-1	20	18 kV	1K	1M	4
	GPX	GPX	30	25 kV	1K	1M	3
	GPX..1	GPX-1	30	25 kV	1K	1M	4
	GVY	GVY	60	30 kV	1K	5M	3
	GVY..1	GVY-1	60	30 kV	1K	5M	4
	GZW	GZW	35	20 kV	1K	1M	3
	GZW..1	GZW-1	35	20 kV	1K	1M	4
	GZZ	GZZ	100	32 kV	1K	10M	3
GZZ..1	GZZ-1	100	32 kV	1K	10M	4	

Note:

- Standard resistance tolerance is $\pm 20\%$. Tolerances of $\pm 15\%$, $\pm 10\%$, and $\pm 5\%$ are available. All resistance values are calibrated at 100 VDC. Calibration at other voltages available upon request.

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: DPW2M50LB191 (preferred part numbering format)

D P W 2 M 5 0 L B 1 9 1

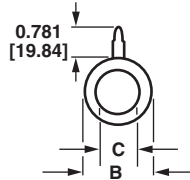
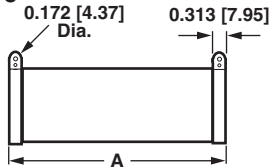
GLOBAL MODEL (See Standard Electrical Specifications table)	RESISTANCE VALUE R = Decimal K = Thousand M = Million 100R = 100 Ω 13K0 = 13 k Ω 500M = 500 M Ω	TOLERANCE CODE J = $\pm 5\%$ K = $\pm 10\%$ L = $\pm 15\%$ M = $\pm 20\%$	PACKAGING E19 = Lead (Pb)-free, Bulk E03 = Lead (Pb)-free, Skin B19 = Tin/Lead, Bulk J03 = Tin/Lead, Skin	SPECIAL Blank = Standard (Dash Number) (up to 3 digits) From 1 - 999 as applicable 1 = Ferrule Terminals
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Historical Part Number example: DPW-12M50L (will continue to be accepted)

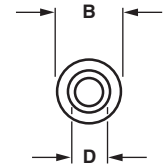
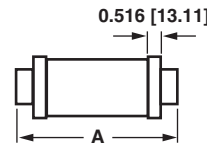
DPW-1	2M50	L	B19
HISTORICAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING

DIMENSIONS in inches [millimeters]

Style 3



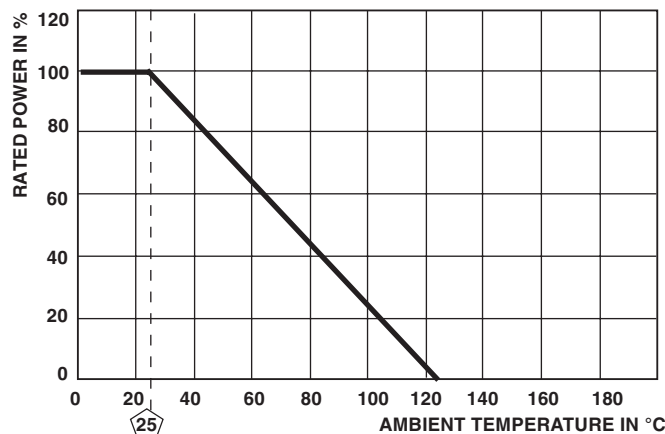
Style 4



GLOBAL MODEL	STYLE	A	B ⁽¹⁾	C	D
DJU	3	4.50 [114.30]	0.750 [19.05]	0.50 [12.70]	N/A
DPW	3	6.50 [165.10]	1.13 [28.70]	0.75 [19.05]	N/A
DPW..1	4	7.69 [195.33]	1.13 [28.70]	N/A	0.812 [20.62]
DPX	3	10.50 [266.70]	1.13 [28.70]	0.75 [19.05]	N/A
DPX..1	4	11.69 [296.93]	1.13 [28.70]	N/A	0.812 [20.62]
DVY	3	14.50 [368.30]	1.50 [38.10]	1.13 [28.70]	N/A
DVY..1	4	15.69 [398.53]	1.50 [38.10]	N/A	1.14 [28.96]
DZW	3	6.50 [165.10]	2.0 [50.80]	1.56 [39.62]	N/A
DZW..1	4	7.69 [195.33]	2.0 [50.80]	N/A	1.14 [28.96]
DZZ	3	18.50 [469.90]	2.0 [50.80]	1.56 [39.62]	N/A
DZZ..1	4	19.69 [500.13]	2.0 [50.80]	N/A	1.14 [28.96]
GJU	3	4.50 [114.30]	0.750 [19.05]	0.50 [12.70]	N/A
GPW	3	6.50 [165.10]	1.13 [28.70]	0.75 [19.05]	N/A
GPW..1	4	7.69 [195.33]	1.13 [28.70]	N/A	0.812 [20.62]
GPX	3	10.50 [266.70]	1.13 [28.70]	0.75 [19.05]	N/A
GPX..1	4	11.69 [296.93]	1.13 [28.70]	N/A	0.812 [20.62]
GVY	3	14.50 [368.30]	1.50 [38.10]	1.13 [28.70]	N/A
GVY..1	4	15.69 [398.53]	1.50 [38.10]	N/A	1.14 [28.96]
GZW	3	6.50 [165.10]	2.0 [50.80]	1.56 [39.62]	N/A
GZW..1	4	7.69 [195.33]	2.0 [50.80]	N/A	1.14 [28.96]
GZZ	3	18.50 [469.90]	2.0 [50.80]	1.56 [39.62]	N/A
GZZ..1	4	19.69 [500.13]	2.0 [50.80]	N/A	1.14 [28.96]

Note:

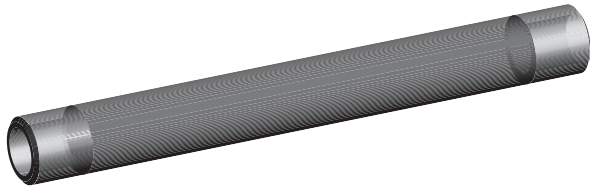
⁽¹⁾ Dimensional tolerances are $\pm 0.016''$ [0.406 mm] or $\pm 1\%$, whichever is greater.



DERATING

PART MARKING	
	- DALE - Model - Value - Tolerance - Date code

Carbon Film Resistors, Special Purpose, High Frequency Load (Tubes)



FEATURES

- High stability and excellent high frequency characteristics
- Particularly suited for high frequency applications involving high power, high accuracy RF measurements
- Carbon film construction

APPLICATIONS

High frequency wattmeters for output measurement in radio, TV and radar transmitters, dielectric heating and similar RF generating equipment. Ideal for use as non-reactive radio frequency terminations. Special high power designs with internal water cooling are available. Contact factory.

STANDARD ELECTRICAL SPECIFICATIONS						
GLOBAL MODEL	HISTORICAL MODEL	POWER RATING WATTAGE FREE AIR $P_{25\text{ }^\circ\text{C}}$ W	RESISTANCE TOLERANCE %	LINEARITY TOLERANCE %	RESISTANCE RANGE Ω	TEMPERATURE COEFFICIENT ppm/ $^\circ\text{C}$
SPW236	SPW-236	120	$\pm 2, \pm 5$	± 10	50 Ω standard. Other values available on special order.	± 200 average ± 250 maximum
SPW227	SPW-227	55	$\pm 2, \pm 5$	± 10		
SPW210	SPW-210	40	$\pm 2, \pm 5$	± 10		
SPW214	SPW-214	10	$\pm 2, \pm 5$	± 10		
SPW212	SPW-212	2	$\pm 2, \pm 5$	± 10		

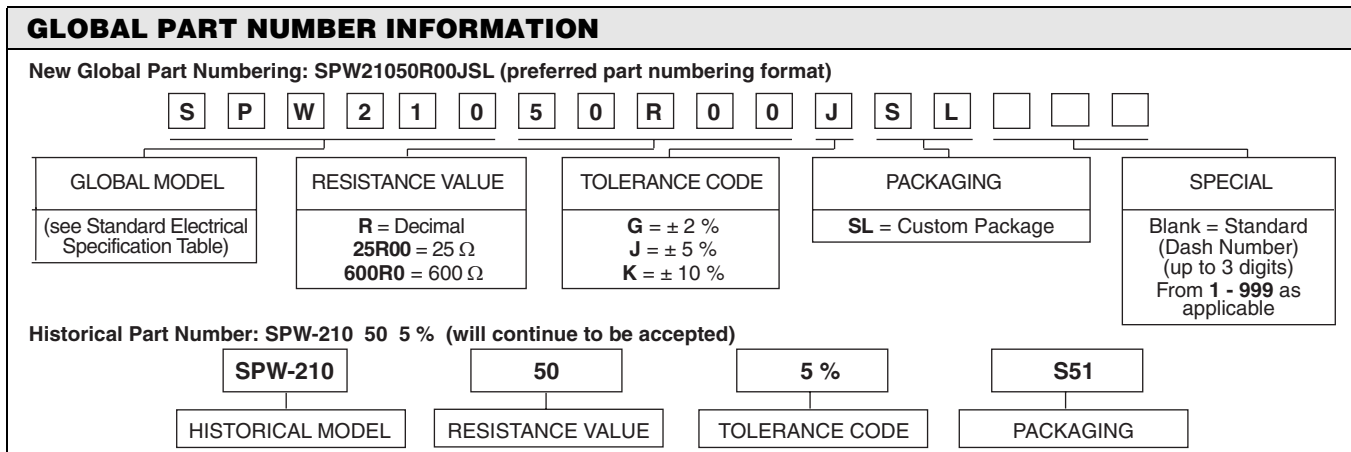
COOLING:

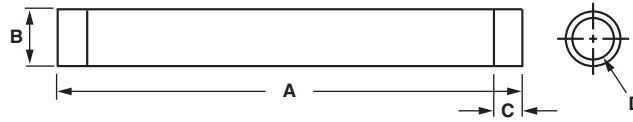
Approximate increase in wattage when forced air cooling is employed is 3 times wattages shown and for liquid cooling (with heat exchanger) is 60 times wattages shown. The limiting factor insofar as the resistor is concerned is the film temperature. This should not exceed + 200 $^\circ\text{C}$ and for maximum stability should not exceed + 150 $^\circ\text{C}$.

MECHANICAL SPECIFICATIONS

Identification:	Type designation resistance value, tolerance and code date of manufacture are printed on each unit.
Terminations:	All types electroplated copper except SPW-212. The SPW-212 has silver coated termination bands.

MARKING
- DALE - Model - Value - Tolerance - Date code



DIMENSIONS in inches [millimeters]


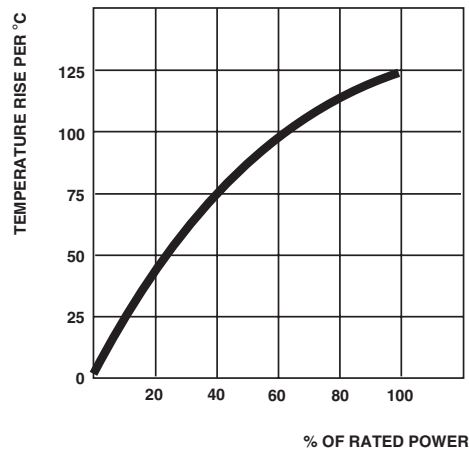
GLOBAL MODEL	A	B	C (O.D.) ⁽²⁾	D (I.D.)
SPW236	18.0 ± 0.062 [457.20 ± 1.57]	1.75 ± 0.025 [44.45 ± 0.64]	1.0 ± 0.063 [25.40 ± 1.60]	1.25 ± 0.025 [31.75 ± 0.64]
SPW227	12.0 ± 0.062 [304.80 ± 1.57]	1.125 ± 0.025 [28.58 ± 0.64]	0.500 ± 0.032 [12.70 ± 0.81]	0.875 ± 0.020 [22.23 ± 0.51]
SPW210	12.0 ± 0.062 [304.80 ± 1.57]	0.875 ± 0.010 [22.23 ± 0.25]	0.625 ± 0.032 [15.88 ± 0.81]	0.625 ± 0.020 [15.88 ± 0.51]
SPW214	5.0 ± 0.032 [127.0 ± 0.81]	0.562 ± 0.006 [14.27 ± 0.81]	0.500 ± 0.032 [12.70 ± 0.81]	0.375 ± 0.013 [9.53 ± 0.33]
SPW212 ⁽¹⁾	2.0 ± 0.062 [50.80 ± 1.57]	0.250 ± 0.006 [6.35 ± 0.15]	0.250 ± 0.032 [6.35 ± 0.81]	Solid Rod

Notes:

⁽¹⁾ Representative types only. Consult factory for special requirements.

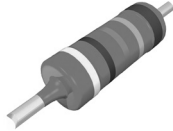
⁽²⁾ C dimension may be varied on special order.

- Wattage ratings do not allow for mounting hardware.


LOAD TEMPERATURE RISE

[Operation in Free Air]

High Pulse Load Leaded Resistors



CBB 0207 leaded resistors with advanced pulse load capability, are the perfect choice for circuitries exposed to high levels of electromagnetic interference or electrostatic discharge. The resistors can also be used to protect the circuitry of signal and mains input lines from surge pulses. Applications are in all fields of automotive, telecommunication and industrial equipment.

METRIC SIZE	
DIN	0207
CECC	B

FEATURES

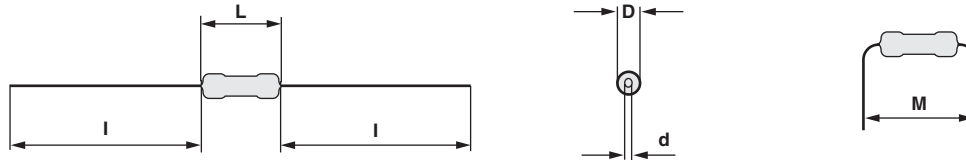
- Speciality product for EMC sensitive applications
- Special carbon film technology for maximum heat stress capability
- Up to 6 kV or 140 W pulse load capability
- Resistance range: 10 Ω to 1.5 MΩ
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)



APPLICATIONS

- Automotive
- Telecommunication
- Industrial equipment

TECHNICAL SPECIFICATIONS			
DESCRIPTION	CBB 0207		
CECC Size	B		
Resistance Range	10 Ω to 1.5 MΩ		
Resistance Tolerance	± 2 %		
Temperature Coefficient	refer to Temperature Coefficient graph		
Operation Mode	long term	standard	
Climatic Category (LCT/UCT/Days)	55/125/56	55/155/56	
Rated Dissipation, P_{70}	0.4 W	0.6 W	
Operating Voltage, U_{max} , AC/DC	350 V		
Film Temperature	125 °C	155 °C	
Max. Resistance Change at P_{70} for Resistance Range, $\Delta R/R$ max., After:	10 Ω to 100 kΩ		
	1000 h	± 1 %	± 2 %
	8000 h	+ 3 %/- 1 %	+ 5 %/- 2 %
Specified Lifetime	225 000 h	8000 h	
Permissible Voltage Against Ambient:	500 V		
	1 Min; U_{ins}	75 V	
Continuous	75 V		
Failure Rate	≤ 0.3 x 10 ⁻⁹ /h		

DIMENSIONS


DIMENSIONS - leaded resistor types, mass and relevant physical dimensions						
TYPE	D _{max.} (mm)	L _{max.} (mm)	d _{nom.} (mm)	l _{min.} (mm)	M _{min.} (mm)	MASS (mg)
CBB 0207	2.5	6.3	0.6	28.0	10.0	220

12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see the 12NC table.
- The remaining 4 digits indicate the resistance value:
 - The first 3 digits indicate the resistance value.
 - The last digit indicates the resistance decade in accordance with the 12NC Indicating Resistance Decade table.

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
10 Ω to 99.9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9.99 kΩ	2
10 kΩ to 99.9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9.99 MΩ	5

12NC Example

The 12NC of a CBB 0207 resistor, value 47 kΩ with ± 2 % tolerance, supplied on bandolier in a box of 5000 units is: 2312 955 24703.

12NC - resistor types and packaging			
DESCRIPTION		ORDERING CODE 2312	
		BANDOLIER IN BOX	
TYPE	TOL.	C1 1000 units	CT 5000 units
CBB 0207	± 2 %	950 2....	955 2....

Resistance ranges printed in bold are preferred TCR/tolerance combinations with optimized availability.

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER: CBB0207001501GC1

C	B	B	0	2	0	7	0	0	1	5	0	1	G	C	1		
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	--	--

MODEL/SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING ⁽¹⁾	SPECIAL
CBB0207	0 = Neutral	0 = Standard See TCR graph	3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 2 = *10 ² 8 = *10 ⁻² 3 = *10 ³ 9 = *10 ⁻¹ 4 = *10 ⁴ 0 = *10 ⁰ 5 = *10 ⁵ 1 = *10 ¹ 6 = *10 ⁶	G = ± 2 %	CT C1	Up to 2 digits 00 = Standard

PRODUCT DESCRIPTION: CBB 0207 2 % C1 1K5

CBB	0207	2 %	C1	1K5
MODEL	SIZE	TOLERANCE	PACKAGING ⁽¹⁾	RESISTANCE VALUE
CBB	0207	± 2 %	CT C1	47K = 47 kΩ 51R1 = 51.1 Ω

Notes:

⁽¹⁾ Please refer to table PACKAGING.

- The PART NUMBER is shown to facilitate the introduction of the unified part numbering system for ordering products.



PACKAGING		
MODEL	BOX	
	PIECES/BOX	CODE
CBB 0207	1000	C1
	5000	CT

TOLERANCE AND RESISTANCE RANGE	
TOLERANCE	RESISTANCE VALUE ⁽¹⁾
	CBB 0207
± 2 %	10 Ω to 1.5 MΩ

Note:

⁽¹⁾ Resistance values to be selected from E24 series.

DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous and dense carbon film is deposited on a high grade ceramic body (85 % Al₂O₃) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the rods. A special laser is used to achieve the target value by smoothly cutting a helical groove in the resistive layer without damaging the ceramics. Connecting wires of electrolytic copper plated with 100% pure tin are welded to the termination caps. The resistors are covered by protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating. Five colour code rings designate the resistance value and tolerance in accordance with **IEC 60 062**.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are stuck directly on the adhesive tapes in accordance with **IEC 60 286-1**.

ASSEMBLY

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. Excellent solderability is proven, even after extended storage. They are suitable for automatic soldering using wave or dipping. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the

whole system. The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. The immunity of the plating against tin whisker growth has been proven under extensive testing. All products comply with the CEFIC-EECA-EICTA list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

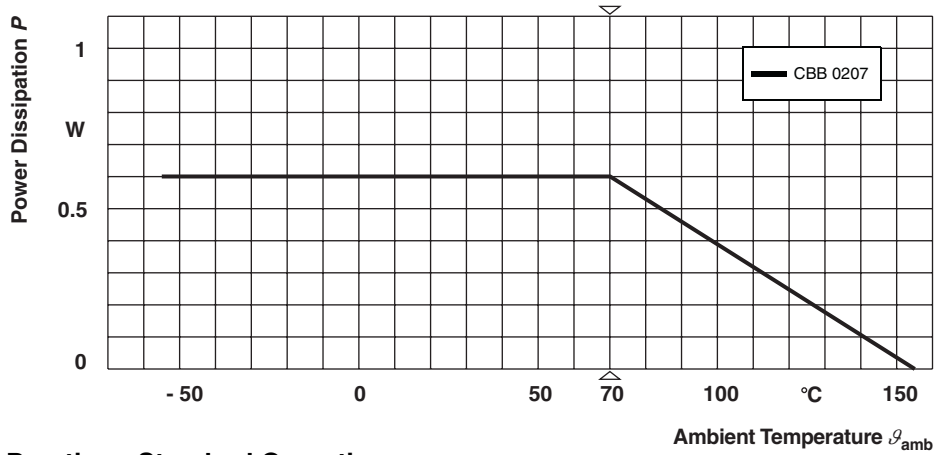
- 2000/53/EC End of Vehicle Life Directive (ELV)
- 2000/53/EC Annex II to End of Vehicle Life Directive (ELV II)
- 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electrical Equipment Directive (WEEE)

APPROVALS

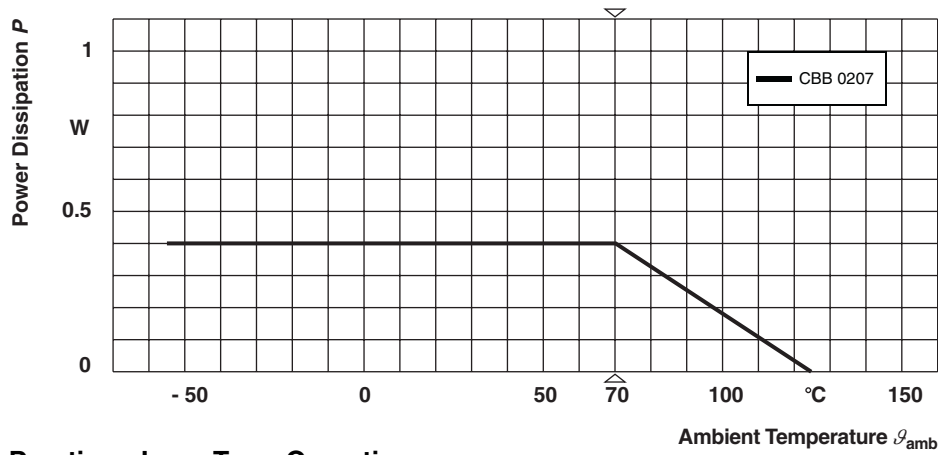
Where applicable, the resistors are tested in accordance with **CECC 40 101-806** which refers to **EN 60 115-1** and **EN 140 100**.

Vishay BEYSCHLAG has achieved “**Approval of Manufacturer**” in accordance with **EN 100 114-1**.

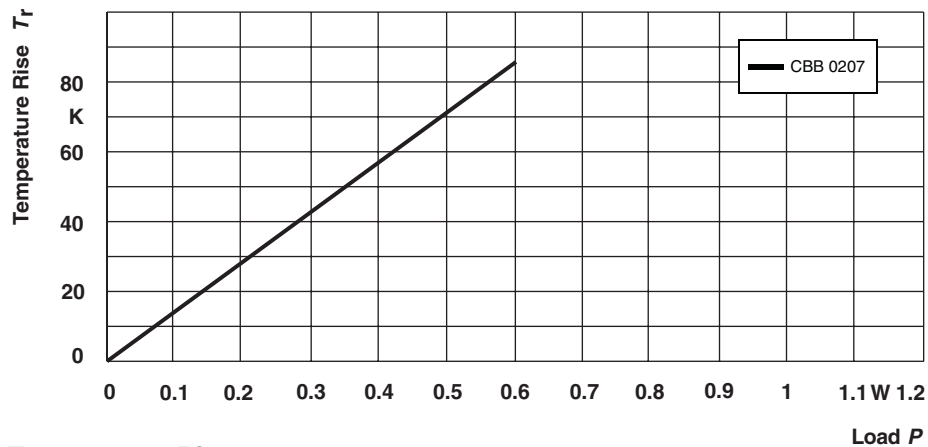
FUNCTIONAL DESCRIPTION



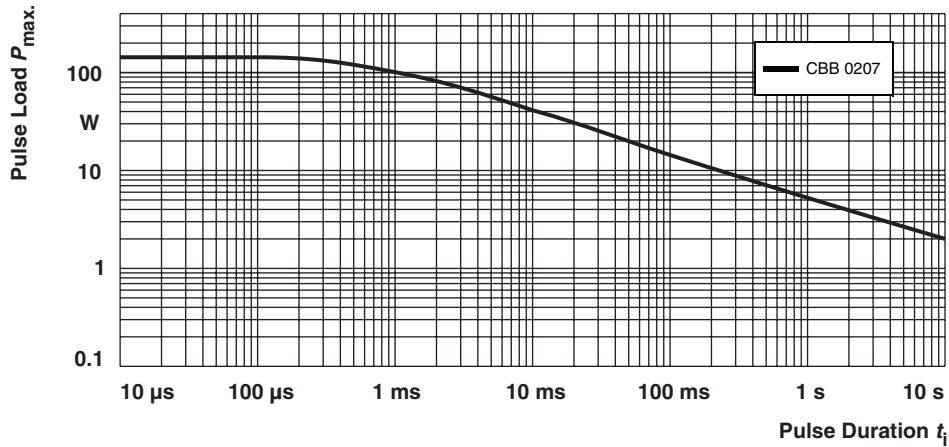
Derating - Standard Operation



Derating - Long Term Operating

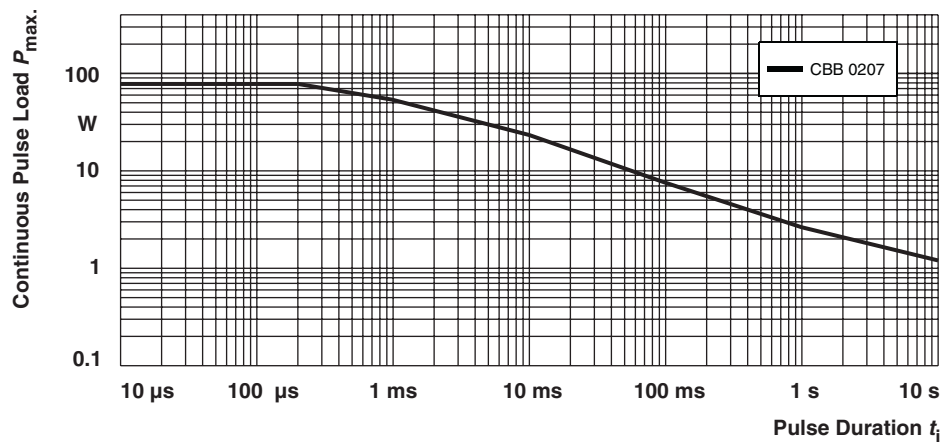


Temperature Rise



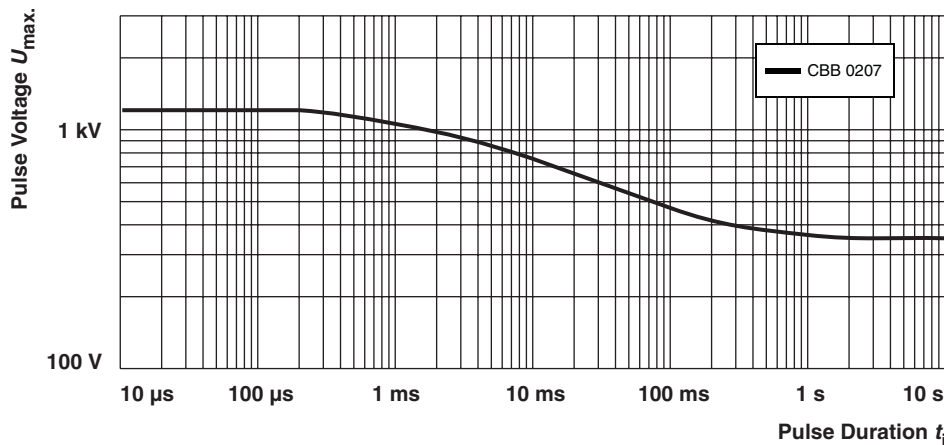
Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation.

Single Pulse



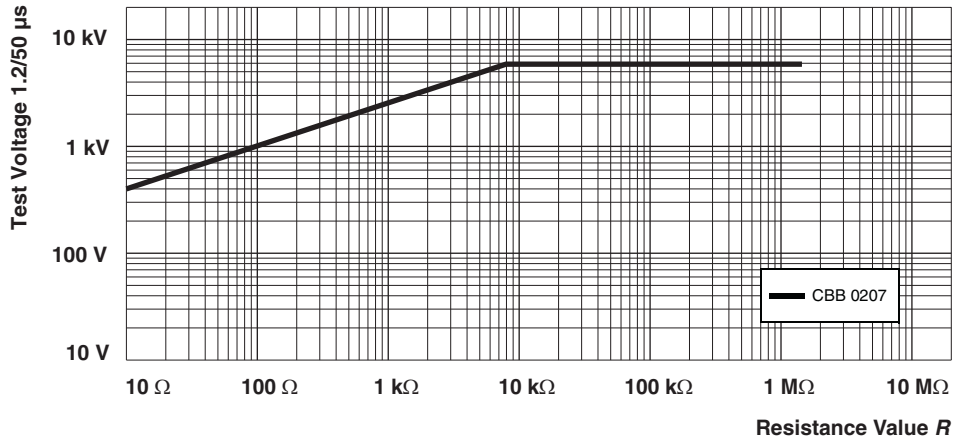
Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Continuous Pulse

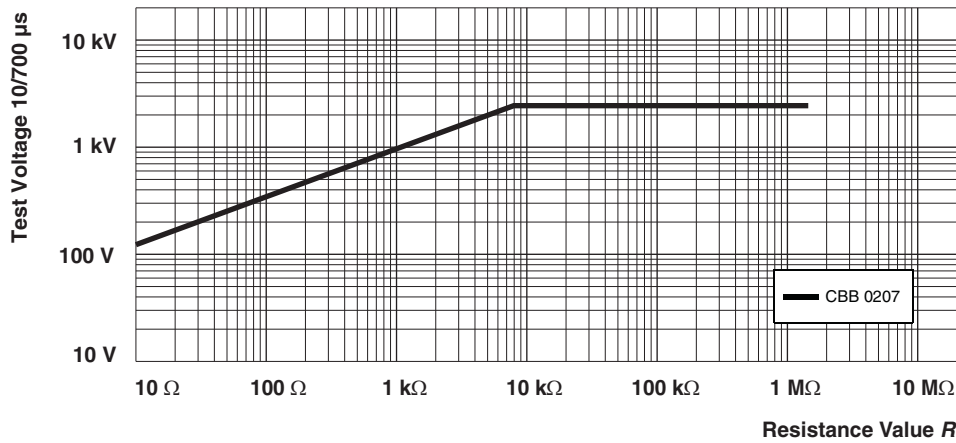


Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation.

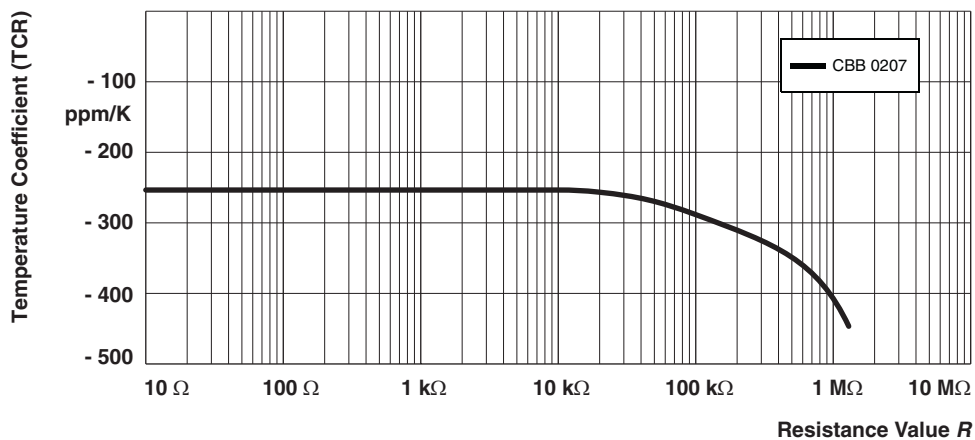
Pulse Voltage

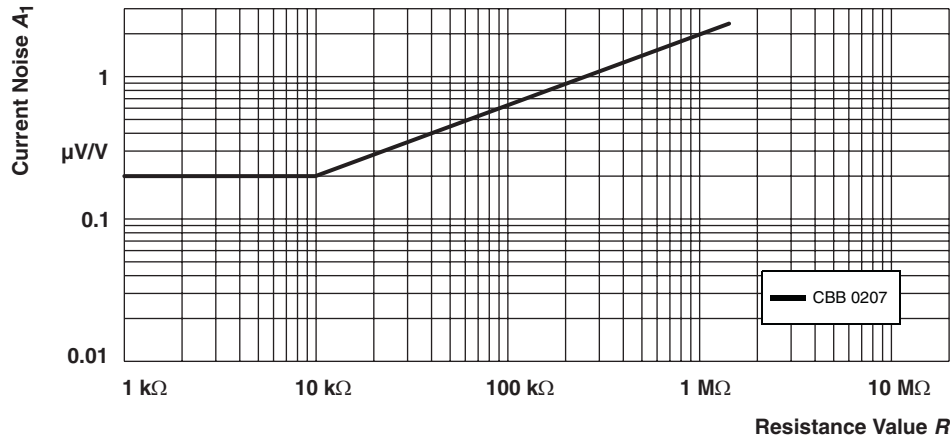


Pulse load rating in accordance with IEC 60115-1, 4.27; 1.2 μ s/50 μ s; 5 pulses at 12 s intervals; for permissible resistance change 0.5 %.

1.2/50 Pulse


Pulse load rating in accordance with IEC 60115-1, 4.27; 10 μ s/ 700 μ s; 10 pulses at 1 minute intervals; for permissible resistance change 0.5 %.

10/700 Pulse

Temperature Coefficient (TCR)



In accordance with IEC 60195

Current Noise - A₁

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the following specifications:

EN 140000/IEC 60115-1, Generic specification (includes tests)

EN 140100/IEC 60115-2, Sectional specification (includes schedule for qualification approval)

CECC 40101-806, Detail specification (includes schedule for conformance inspection)

The following table contains the applicable tests selected from the documents listed above.

The tests are carried out in accordance with IEC 60 068 and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3. Climatic category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper

Category Temperature; damp heat, long term, 56 days) is valid.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 45 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

For testing the components are mounted on a test board in accordance with IEC 60115-1, 4.31 unless otherwise specified.

In the Test Procedures and Requirements table only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2; a short description of the test procedure is also given.

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)
			Stability for product types: CBB 0207	10 Ω to 1.5 MΩ
4.5	-	resistance		± 2 %
4.8.4.2	-	temperature coefficient	at 20/LCT/20 °C and 20/UCT/20 °C	-
4.25.1	-	endurance at 70 °C: standard operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$ 1.5 h ON; 0.5 h OFF 70 °C; 1000 h 70 °C; 8000 h	± (2 % R + 0.05 Ω) ± (4 % R + 0.05 Ω)

TEST PROCEDURES AND REQUIREMENTS - continued				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	Requirements Permissible change (ΔR)
			Stability for product types: CBB 0207	10 Ω to 1.5 M Ω
4.25.1	-	endurance at 70 °C: long term operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max}$; 1.5 h ON; 0.5 h OFF 70 °C; 1000 h 70 °C; 8000 h	$\pm (1 \% R + 0.05 \Omega)$ $\pm (2 \% R + 0.05 \Omega)$
4.25.3	-	endurance at upper category temperature	125 °C; 1000 h 155 °C; 1000 h	$\pm (2 \% R + 0.05 \Omega)$ $\pm (4 \% R + 0.1 \Omega)$
4.24	78 (Cab)	damp heat, steady state	(40 \pm 2) °C; 56 days; (93 \pm 3) % RH	$\pm (1 \% R + 0.1 \Omega)$
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	155 °C; 16 h 55 °C; 24 h;	
4.23.3	30 (Db)	damp heat, cyclic	90 to 100 % RH; 1 cycle	
4.23.4	1 (Aa)	cold	- 55 °C; 2 h	
4.23.5	13 (M)	low air pressure	8.5 kPa; 2 h; 15 to 35 °C	
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	$\pm (1 \% R + 0.1 \Omega)$ no visible damage
-	1 (Aa)	cold	- 55 °C; 2 h	$\pm (0.5 \% R + 0.1 \Omega)$
4.13	-	short time overload	room temperature; $U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	$\pm (0.5 \% R + 0.1 \Omega)$ no visible damage
4.19	14 (Na)	rapid change of temperature	30 min at LCT and 30 min at UCT; 5 cycles	$\pm (0.5 \% R + 0.05 \Omega)$ no visible damage
4.29	45 (XA)	component solvent resistance	isopropyl alcohol + 23 °C; toothbrush method	marking legible; no visible damage
4.18.2	20 (Tb)	resistance to soldering heat	unmounted components; (260 \pm 5) °C; (10 \pm 1) s	$\pm (0.5 \% R + 0.05 \Omega)$ no visible damage
4.17	20 (Ta)	solderability	+ 235 °C; 2 s solder bath method	good tinning ($\geq 95 \%$ covered); no visible damage
4.22	6 (B4)	vibration	6 h; 10 to 2000 Hz 1.5 mm or 196 m/s ²	$\pm (0.5 \% R + 0.05 \Omega)$
4.16	21 (Ua ₁) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	$\pm (0.5 \% R + 0.05 \Omega)$
4.7	-	voltage proof	$U_{RMS} = U_{ins}$; 60 s	no flashover or breakdown



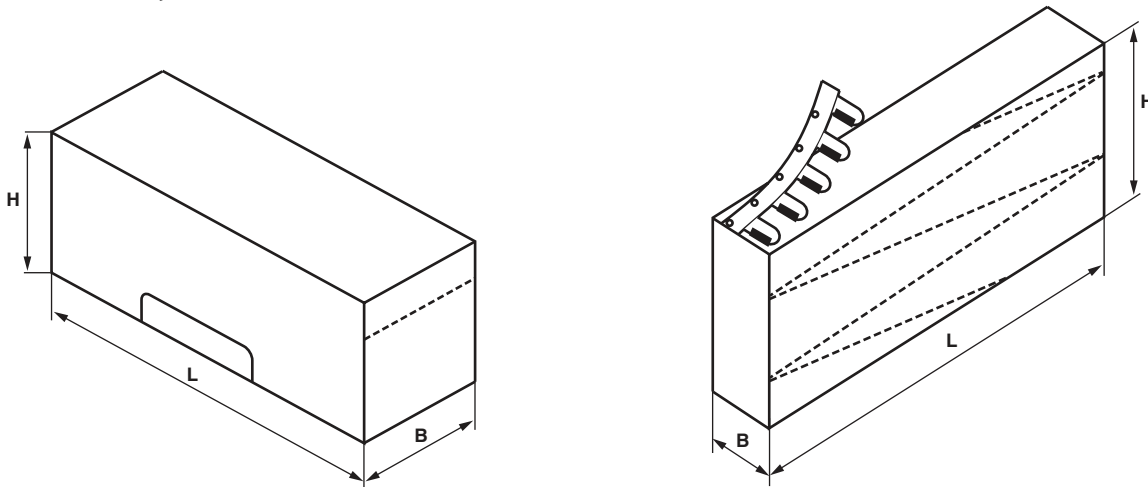


Related Documents

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Taping and Packaging	252
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BOX PACKAGING, AMMO TAPED

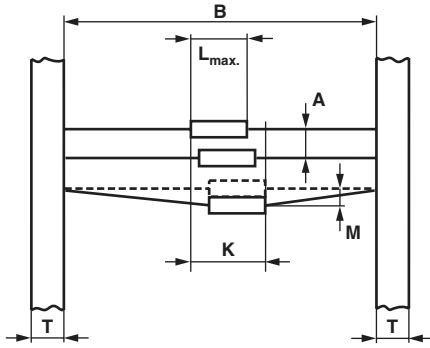


MODEL	TAPE	PACKAGING CODE	BOX DIMENSIONS [in millimeters]			PACKAGING UNIT PIECES
			L	B	H	
0204	G26	A4	253	51	64	4000
0204	G53	A2	224	82	39	2000
0204	G53	A5	345	83	61	5000
0207	G26	A2	253	51	64	2000
0207	G53	A2	224	82	54	2000
0207	G53	A5	345	83	85	5000
0309	G53	A2	224	82	74	2000
0309	G53	A5	345	83	115	5000
0411	G53	A1	324	82	49	1000
0411	G73	A1	324	101	49	1000
0411 ⁽¹⁾	G73	A1	324	101	64	1000
0414	G53	A1	324	82	49	1000
0414	G73	A1	324	101	49	1000
4 (0414)	G73	A1	200	102	90	1000
0617	G83	A1	324	111	75	1000
0617 ⁽¹⁾	G83	AC	324	111	80	500
5 (0617)	G77	A1	405	115	93	1000
0719	G83	AC	324	111	75	500
0922	G83	AB	324	111	75	250
8 (0922)	G77	AC	412	118	110	500
0933	G83	AB	324	111	75	250
0207	Radial	A4	334	46	200	4000
0411	Radial	A2	334	53	147	2000

Note:

⁽¹⁾ SXA

TAPE DIMENSIONS



Note:

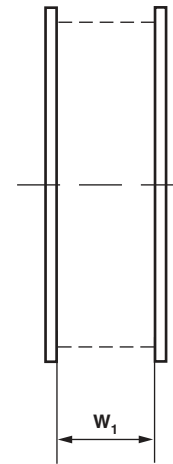
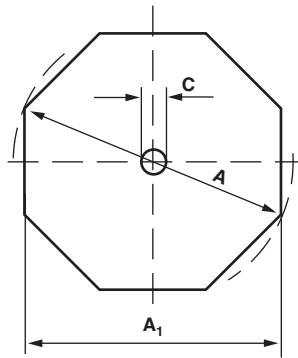
- $L_{max.}$ see data sheets

TAPE	DIMENSIONS [in millimeters]				
	B	A	K	M	T
G26	26 ± 1.5	5 ± 0.5	$L_{max.} + 1.0$	1.0	6 ± 0.5
G53	53 ± 1	5 ± 0.5	$L_{max.} + 1.4$	1.2	6 ± 0.5
G73	73 ± 1	5 ± 0.5	$L_{max.} + 1.4$	1.2	6 ± 0.5
G83	83 ± 1	10 ± 0.5	$L_{max.} + 1.4$	1.2	6 ± 0.5
G83	83 ± 1	10 ± 0.5	$L_{max.} + 1.4$	1.2	9 ± 0.5

Note:

- Taping corresponds to IEC 60286-1

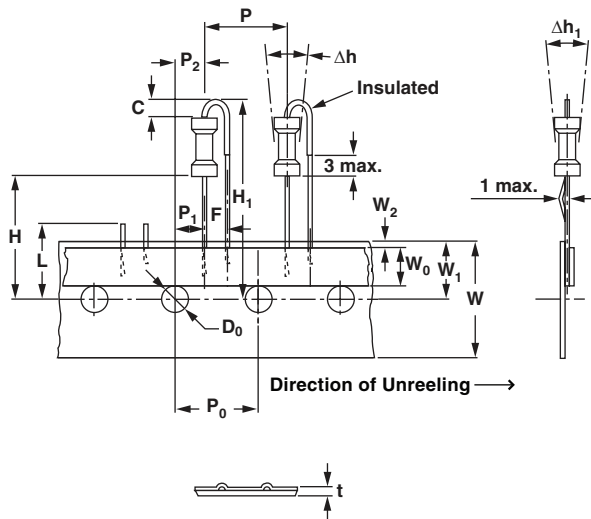
REEL PACKAGING



MODEL	TAPE	PACKAGING CODE	BOX DIMENSIONS [in millimeters]				PACKAGING UNIT PIECES
			A_1	A	C	W_1	
0204	G53	R5	250	270	20	75	5000
0207	G53	R5	290	315	20	75	5000
0309	G53	R5	290	315	20	75	5000/3000
0411	G53	RE	250	270	20	75	2500
0411	G73	RE	250	270	20	95	2500
0414	G73	R2	250	270	20	95	2000
4 (0414)	G73	RE	290	315	20	95	2500
0617	G83	R1	250	270	20	105	1000
5 (0617)	G77	RP	350	380	20	105	1500
0719	G83	RC	250	270	20	105	500
0922	G83	RC	250	270	20	105	500
8 (0922)	G77	R1	350	380	20	105	1000
0933	G83	RC	250	270	20	105	500
0207	Radial	R4	-	350	30	44	4000

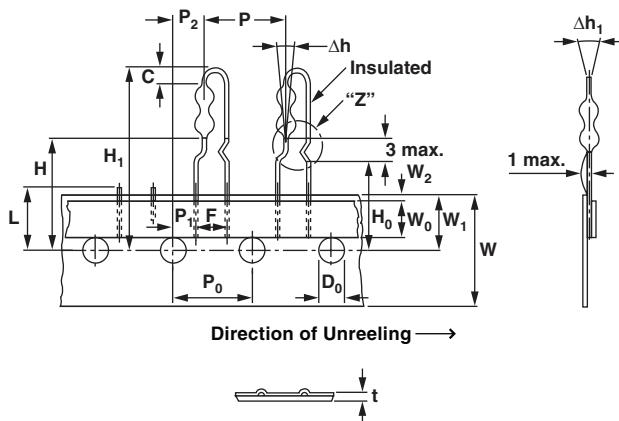
TAPING OF RADIAL COMPONENTS, IEC 60286-2 - PANASERT

LEAD SPACING 2.5 mm, SIZE 0207

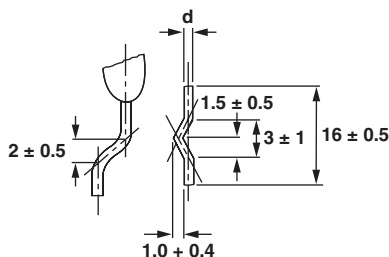


DIMENSIONS [in millimeters]			TOL.
Lead Ø	d	0.6	-
Pitch of components	P	12.7	± 1.0
Pitch of sprocket holes ⁽¹⁾	P ₀	12.7	± 0.3
Distance between hole center and lead center	P ₁	5.1	± 0.7
Distance between hole center and resistor center	P ₂	5.1	± 0.7
Lead spacing	F	2.5	+ 0.6, - 0.1
Angle of insertion	Δh	1.3 max.	-
Angle of insertion	Δh ₁	2 max.	-
Width of carrier tape	W	18.0	+ 1, - 0.5
Width of adhesive tape	W ₀	6.0	± 0.5
Position of holes	W ₁	9.0	+ 0.75, - 0.5
Position of adhesive tape	W ₂	0.5	+ 0.5, - 0
Body to hole center ⁽²⁾	H	18.0	± 2, - 0
Hole Ø	D ₀	4.0	+ 0.2
Thickness of tape ⁽³⁾	t	0.9 max.	-
Height for cutting	L	11 max.	-
Height for bending	C	2.5	+ 0, - 0.5
Height for insertion	H ₁	32 max.	-

LEAD SPACING 5.0 mm, SIZE 0207



Area "Z"



DIMENSIONS [in millimeters]			TOL.
Lead Ø	d	0.6	-
Pitch of components	P	12.7	± 1.0
Tape pitch	P ₀	12.7	± 0.3
Distance between hole center and lead center	P ₁	3.85	± 0.7
Distance between hole center and resistor center	P ₂	6.35	± 0.7
Lead spacing	F	5.0	+ 0.6, - 0.1
Angle of insertion	Δh	1.3 max.	-
Angle of insertion	Δh ₁	2 max.	-
Width of carrier tape	W	18.0	+ 1, - 0.5
Width of adhesive tape	W ₀	6.0	± 0.5
Position of holes	W ₁	9.0	+ 0.75, - 0.5
Position of adhesive tape	W ₂	0.5	+ 0.5, - 0
Body to hole center ⁽²⁾	H	18.0	± 2, - 0
Lead crimp to hole center ⁽²⁾	H ₀	16.0	± 0.5
Hole Ø	D ₀	4.0	± 0.2
Thickness of tape ⁽³⁾	t	0.9 max.	-
Height for cutting	L	11 max.	-
Height for bending	C	2.5	+ 0, - 0.5
Height for insertion	H ₁	32 max.	-

Notes:

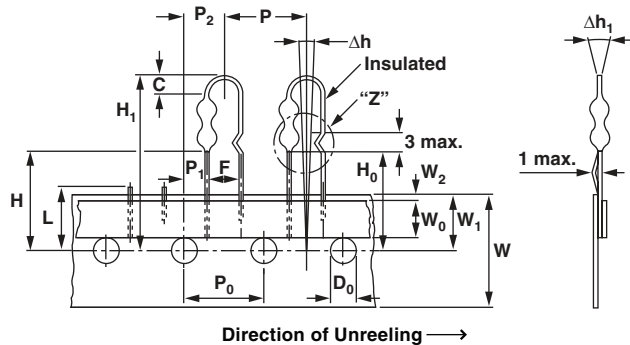
(1) Test over 10 holes - 9 intervals P₀ 12 x 9 = 114.3 ± 0.5

(2) Parallelism, < 0.5 mm

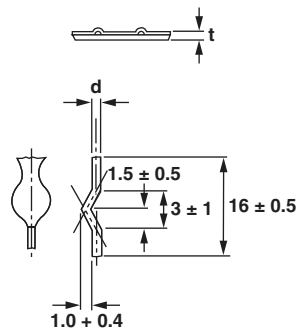
(3) Thickness of carrier tape: 0.55 mm ± 0.1

TAPING OF RADIAL COMPONENTS, IEC 60286-2 - AVISERT

LEAD SPACING 5.0 mm, SIZE 0207, Version A

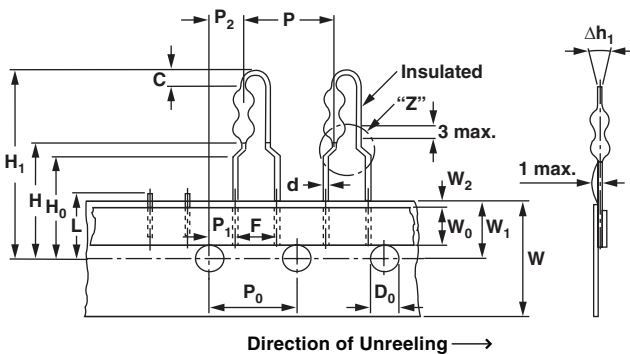


Area "Z"

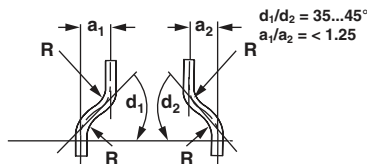


DIMENSIONS [in millimeters]			TOL.
Lead Ø	d	0.6	-
Pitch of components	P	12.7	± 1.0
Pitch of sprocket holes	P ₀	12.7	± 0.3
Distance between hole center and resistor center	P ₁	3.85	± 0.7
Distance between hole center and lead center	P ₂	6.35	± 0.7
Lead spacing	F	5.0	+ 0.6, - 0.1
Angle of insertion	Δh	1.3 max.	-
Angle of insertion	Δh ₁	2 max.	-
Width of carrier tape	W	18.0	+ 1, - 0.5
Width of adhesive tape	W ₀	6.0	± 0.5
Position of holes	W ₁	9.0	+ 0.75, - 0.5
Position of adhesive tape	W ₂	0.5	+ 0.5, - 0
Body to hole center	H	11.5	± 1.0
Lead crimp to hole center ⁽²⁾	H ₀	16.5	± 0.5
Hole Ø	D ₀	4.0	± 0.2
Thickness of tape ⁽³⁾	t	0.9 max.	-
Height for cutting	L	11 max.	-
Height for bending	C	2.5	+ 0, - 0.5
Height for insertion	H ₁	32 max.	-

LEAD SPACING 5.0 mm, SIZE 0207/0411, Version B



Area "Z"



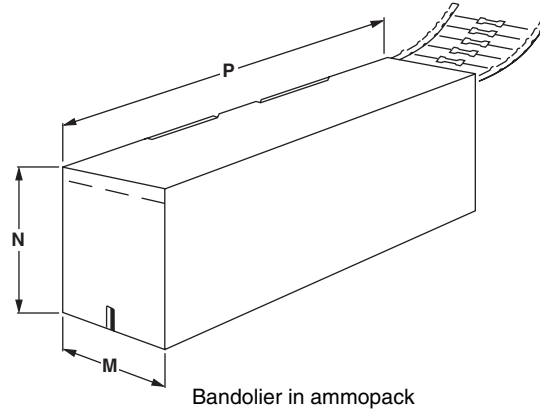
DIMENSIONS [in millimeters]			TOL.
Lead Ø	d	0.6	-
Pitch of components	P	12.7	± 1.0
Pitch of sprocket holes ⁽¹⁾	P ₀	12.7	± 0.3
Distance between hole center and resistor center	P ₁	3.85	± 0.7
Distance between hole center and lead center	P ₂	6.35	± 0.7
Lead spacing	F	5.0	+ 0.6, - 0.1
Angle of insertion	Δh	1.3 max.	-
Angle of insertion	Δh ₁	2 max.	-
Width of carrier tape	W	18.0	+ 1, - 0.5
Width of adhesive tape	W ₀	0207: 6.0 0411: 12.0	± 0.5
Position of holes	W ₁	9.0	+ 0.75, - 0.5
Position of adhesive tape	W ₂	0.5	+ 0.5, - 0
Body to hole center	H	19.5	± 1.0
Lead crimp to hole center ⁽²⁾	H ₀	16.0	± 0.5
Hole Ø	D ₀	4.0	± 0.2
Thickness of tape ⁽³⁾	t	0.9 max.	-
Height for cutting	L	11 max.	-
Height for bending	C	2.5	+ 0, - 0.5
Height for insertion	H ₁	32 max.	-

Notes:

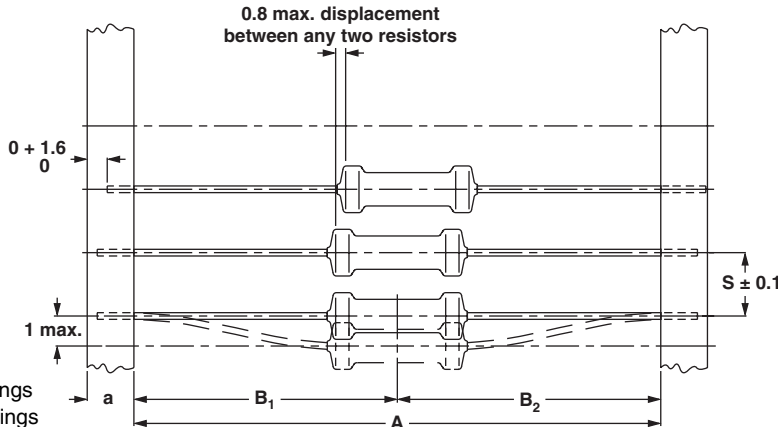
- (1) Test over 10 holes - 9 intervals P₀ 12 x 9 = 114.3 ± 0.5
- (2) Parallelism, < 0.5 mm
- (3) Thickness of carrier tape: 0.55 mm ± 0.1

Linear Leaded Resistors

DIMENSIONS OF AMMOPACK



Bandolier in ammopack



Axial style on tape

Dimensions in millimeters
 Maximum 1 mm per 10 spacings
 Maximum 0.5 mm per 5 spacings

DIMENSIONS in millimeters - resistor type, quantities and packaging dimensions for axial taped in ammopack								
PRODUCT TYPE	QUANTITY	PACKAGING DIMENSIONS						
		AXIAL TAPED ON BANDOLIER				AMMOPACK		
		a	A	B ₁ - B ₂	S	M	N	P
SFR16S	1000	6 ± 0.5	52.5 ± 1.5	± 1.2	5	75	30	140
	5000	6 ± 0.5	52.5 ± 1.5	± 1.2	5	75	73	270
SFR25	1000	6 ± 0.5	52 + 1.5/- 0	± 1.2	5	82	28	262
	5000	6 ± 0.5	52 + 1.5/- 0	± 1.2	5	78	98	270
SFR25H	1000	6 ± 0.5	52 + 1.5/- 0	± 1.2	5	82	28	262
	5000	6 ± 0.5	52 + 1.5/- 0	± 1.2	5	78	98	270
MBA/SMA 0204	1000	6 ± 0.5	53 ± 2.0	± 1.2	5	75	40	187
	5000	6 ± 0.5	53 ± 2.0	± 1.2	5	75	55	330
MBB/SMA 0207	1000	6 ± 0.5	53 ± 1.0	± 1.2	5	75	40	187
	5000	6 ± 0.5	53 ± 1.0	± 1.2	5	75	85	330
MBE/SMA 0414	1000	6 ± 0.5	63 ± 2.0	± 1.2	5	45	88	378
UXA 0204	100	6 ± 0.5	53 ± 2.0	± 1.2	5	75	40	187
	1000	6 ± 0.5	53 ± 2.0	± 1.2	5	75	40	187
UXB 0207 MPR24	100	6 ± 0.5	53 ± 2.0	± 1.2	5	75	40	187
	1000	6 ± 0.5	53 ± 2.0	± 1.2	5	75	40	187
UXE 0414	100	6 ± 0.5	63 ± 2.0	± 1.2	5	45	88	378
	1000	6 ± 0.5	63 ± 2.0	± 1.2	5	45	88	378

DIMENSIONS in millimeters - resistor type, quantities and packaging dimensions for axial taped in ammopack								
PRODUCT TYPE	QUANTITY	PACKAGING DIMENSIONS						
		AXIAL TAPED ON BANDOLIERS				AMMOPACK		
		a	A	B ₁ - B ₂	S	M	N	P
NFR25	1000	6 ± 0.5	52 + 1.5/-0	± 1.2	5	82	28	262
	5000	6 ± 0.5	52 + 1.5/-0	± 1.2	5	78	98	270
NFR25H	1000	6 ± 0.5	52 + 1.5/-0	± 1.2	5	82	28	262
	5000	6 ± 0.5	52 + 1.5/-0	± 1.2	5	78	98	270
VR25	1000	6 ± 0.5	52 + 1.5/-0	± 1.2	5	82	28	262
	2000	6 ± 0.5	26 + 1.5/-0	± 1.2	5	50	50	255
	5000	6 ± 0.5	52 + 1.5/-0	± 1.2	5	76	120	260
VR37	1000	6 ± 0.5	52 + 1.5/-0	± 1.2	5	76	60	262
VR68	500	5 ± 0.5	66.7 ± 1.5	± 1.2	10	85	112	258
LSR37	1000	6 ± 0.5	52 + 1.5/-0	± 1.2	5	76	60	262
CBB 0207	1000	6 ± 0.5	53 ± 2.0	± 1.2	5	75	40	187
	5000	6 ± 0.5	53 ± 2.0	± 1.2	5	75	85	330
MBA/SMA 0204 HF	1000	6 ± 0.5	53 ± 2.0	± 1.2	5	75	30	187
	5000	6 ± 0.5	53 ± 2.0	± 1.2	5	75	55	330
PR01	1000	6 ± 0.5	53 ± 2.0	± 1.2	5	97	28	262
	5000	6 ± 0.5	52 ± 2.0	± 1.2	5	76	120	260
PR02	1000	6 ± 0.5	52 ± 2.0	± 1.2	5	76	60	262
PR03	500	6 ± 0.5	63 ± 2.0	± 1.2	5	85	50	259
AC01	1000	6 ± 0.5	63 ± 2.0	± 1.2	10	80	55	260
AC03	500	6 ± 0.5	63 ± 2.0	± 1.2	10	80	55	260
AC04	500	6 ± 0.5	63 ± 2.0	± 1.2	10	80	70	260
AC05	500	6 ± 0.5	63 ± 2.0	± 1.2	10	80	105	265
AC07	500	6 ± 0.5	74 ± 2.0	± 1.2	10	90	105	265
AC10	500	6 ± 0.5	89 ± 4	± 1.2	10	105	105	265
PAC01	1000	6 ± 0.5	63 ± 1	± 1.2	10	80	55	260
PAC02	500	6 ± 0.5	63 ± 1	± 1.2	10	80	55	260
PAC03	500	6 ± 0.5	63 ± 1	± 1.2	10	80	70	260
PAC04	500	6 ± 0.5	63 ± 1	± 1.2	10	80	105	265
PAC05	500	6 ± 0.5	71 ± 1	± 1.2	10	90	105	265
PAC06	500	6 ± 0.5	71 ± 1	± 1.2	10	90	105	265
AC01RT ⁽¹⁾	2000	6 ± 0.5	71 ± 1	± 1.2	10	147	53	334

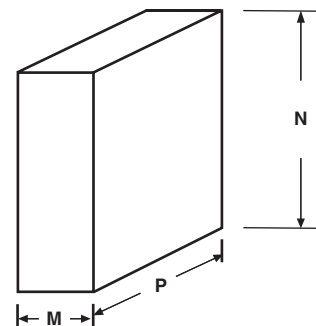
Note:

⁽¹⁾ Material for Radial Tape.

DIMENSIONS OF REEL PACKAGING (AXIAL TAPED)				
PRODUCT TYPE	QUANTITY	OUTER PACKAGING DIMENSIONS (for Bandolier on reel)		
		M (mm)	N (mm)	P (mm)
SFR16S	5000	92	278	278
SFR25	5000	92	311	311
SFR25H	5000	92	311	311
NFR25	5000	92	311	311
NFR25H	5000	92	311	311
VR25	5000	92	311	311
VR37	5000	92	375	375
VR68	750	110	320	320
PR01	5000	92	311	311
PR02	5000	92	375	375

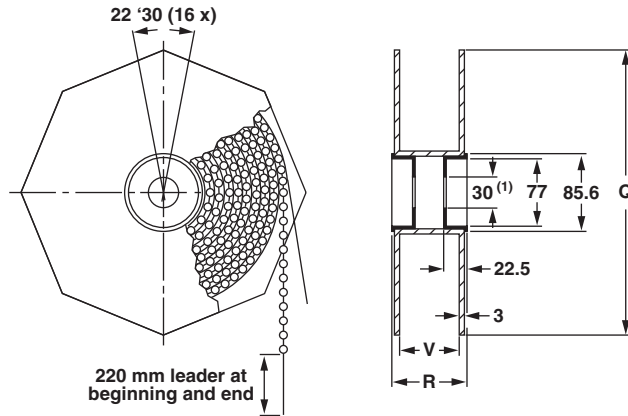
Note:

- For MBA/SMA 0204, MBB/SMA 0207, MBE/SMA 0414 reel packaging is without outer box packaging



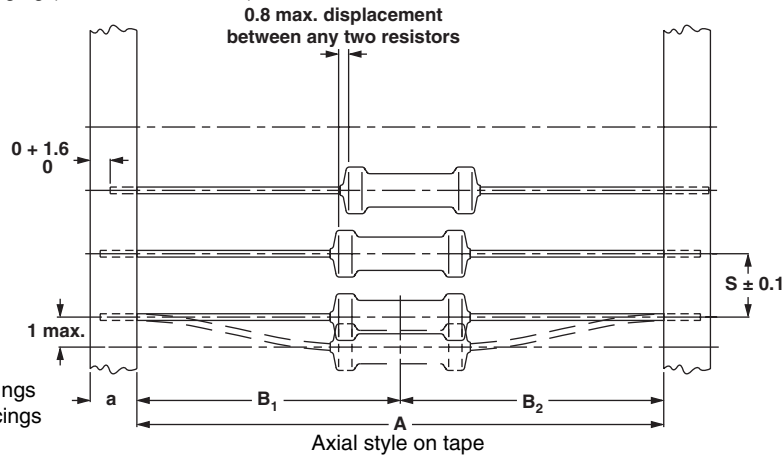
Dimensions of outer packaging (for axial taped bandolier on reel)

DIMENSIONS OF REEL in millimeters



Note:

(1) Dimensions of inner packaging (for bandolier on reel)

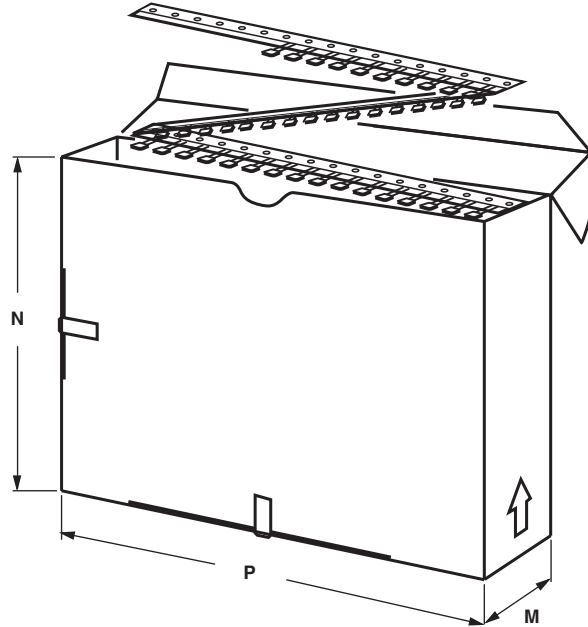


Maximum 1 mm per 10 spacings
Maximum 0.5 mm per 5 spacings

DIMENSIONS in millimeters - resistor type, quantities and packaging dimensions for axial taped on reel

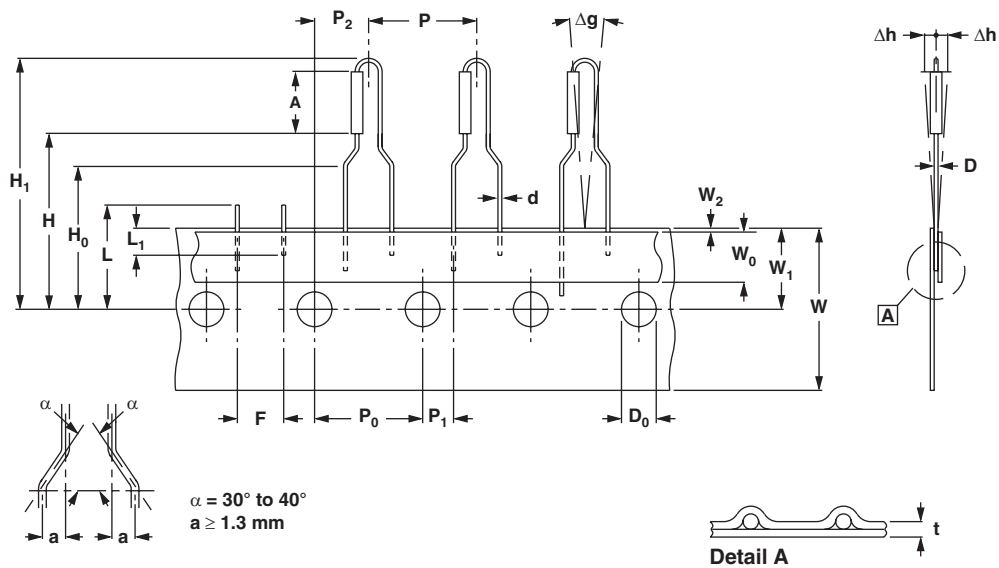
PRODUCT TYPE	QUANTITY	PACKAGING DIMENSIONS						
		AXIAL TAPED ON BANDOLIER				REEL		
		a	A	B ₁ - B ₂	S	Q	V	R
SFR16S	5000	6 ± 0.5	52.5 ± 1.5	± 1.2	5	265	75	86
SFR25	5000	6 ± 0.5	52 + 1.5/- 0	± 1.2	5	305	75	86
SFR25H	5000	6 ± 0.5	52 + 1.5/- 0	± 1.2	5	305	75	86
MBA/SMA 0204	1000	6 ± 0.5	53 ± 2.0	± 1.2	5	315	70	80
MBA/SMA 0204	5000	6 ± 0.5	53 ± 2.0	± 1.2	5	315	70	80
MBB/SMA 0207	1000	6 ± 0.5	53 ± 1.0	± 1.2	5	315	70	80
MBB/SMA 0207	5000	6 ± 0.5	53 ± 1.0	± 1.2	5	315	70	80
MBE/SMA 0414	2500	6 ± 0.5	63 ± 2.0	± 1.2	5	315	80	90
UXA 0204	1000	6 ± 0.5	53 ± 2.0	± 1.2	5	315	70	80
UXA 0204	5000	6 ± 0.5	53 ± 2.0	± 1.2	5	315	70	80
UXB 0207 MPR24	1000	6 ± 0.5	53 ± 2.0	± 1.2	5	315	70	80
UXB 0207 MPR24	5000	6 ± 0.5	53 ± 2.0	± 1.2	5	315	70	80
NFR25	5000	6 ± 0.5	52 + 1.5/- 0	± 1.2	5	305	75	86
NFR25H	5000	6 ± 0.5	52 + 1.5/- 0	± 1.2	5	305	75	86
VR25	5000	6 ± 0.5	52 + 1.5/- 0	± 1.2	5	305	75	86
VR37	5000	6 ± 0.5	52 + 1.5/- 0	± 1.2	5	356	75	86
VR68	750	6 ± 0.5	66.7 ± 1.5	± 1.2	10	305	75	86
LSR37	5000	6 ± 0.5	52 + 1.5/- 0	± 1.2	5	356	75	86
PR01	5000	6 ± 0.5	52 ± 2.0	± 1.2	5	305	75	86
PR02	5000	6 ± 0.5	52 ± 2.0	± 1.2	5	356	75	86

DIMENSIONS OF AMMOPACK (RADIAL TAPED) in millimeters



Dimensions of ammpack (radial taped)

PRODUCTS WITH RADIAL LEADS (SFR25, SFR25H, NFR25, NFR25H, VR25, PR01, PR02)



Bandolier for types with radial leads

RADIAL PRODUCT DIMENSIONS (TAPED)					
SYMBOL	PARAMETER	TYPE	VALUE	TOLERANCE	UNIT
D	maximum body diameter	see detailed product specification			mm
A	maximum body length				mm
d	lead wire diameter				mm
H ₁	component height	SFR25	29	max.	mm
		NFR25	29	max.	mm
		NFR25H	29	max.	mm
		PR01	29	max.	mm
		VR25	29	max.	mm
		PR02	29	± 3.0	mm
		MBB/SMA 0207	28	max.	mm

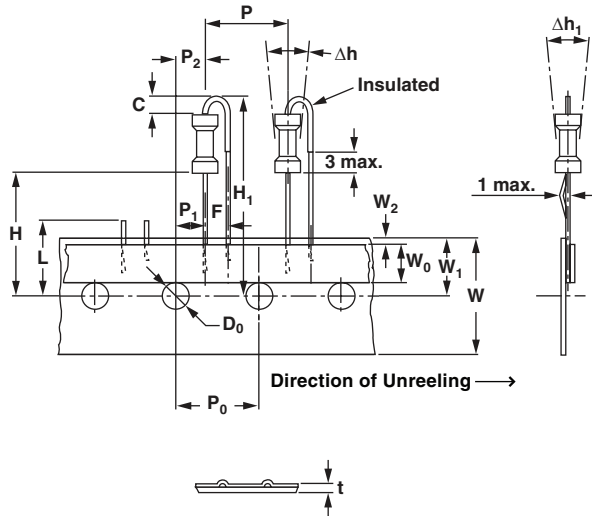
DIMENSIONS OF AMMOPACK (RADIAL TAPED)

DIMENSIONS IN MILLIMETERS - resistor type, quantities and dimensions of the packaging for radial taped in ammpack				
PRODUCT TYPE	QUANTITY	PACKAGING DIMENSIONS		
		AMMOPACK		
		M	N	P
SFR25	4000	45	262	330
NFR25	4000	45	262	330
NFR25H	4000	45	262	330
PR01	4000	45	262	330
VR25	4000	45	262	330
PR02	3000	45	262	330
MBB/SMA 0207	4000	45	262	330

TAPE DIMENSIONS				
SYMBOL	PARAMETER	VALUE	TOLERANCE	UNIT
P	pitch of components	12.7	± 1.0	mm
P ₀	feed-hole pitch	12.7	± 0.2	mm
	cumulative pitch error per 20 spacings		1.0	mm
P ₁	feed-hole centre to lead at topside at the tape	3.85	± 0.5	mm
P ₂	feed-hole center to body center	6.35	± 1.0	mm
F	lead-to-lead distance	4.8	+ 0.7/- 0	mm
Δh	component alignment	0	± 1.2	mm
Δg	component alignment	0	± 3	deg
W	tape width	18.0	± 0.5	mm
W ₀	minimum hold down tape width	5.5	-	mm
W ₁	hole position	9.0	± 0.5	mm
W ₂	maximum hold down tape position	0.5	-	mm
H ₀	lead wire clinch height	16.5	± 0.5	mm
H	height of component from tape center	19.5	± 1	mm
D ₀	feed-hole diameter	4.0	± 0.2	mm
t	total tape thickness	0.4	- 0/+ 0.5	mm
L	maximum length of snapped lead	11.0	-	mm
L ₁	minimum lead wire (tape portion) shortest lead	2.5	-	mm

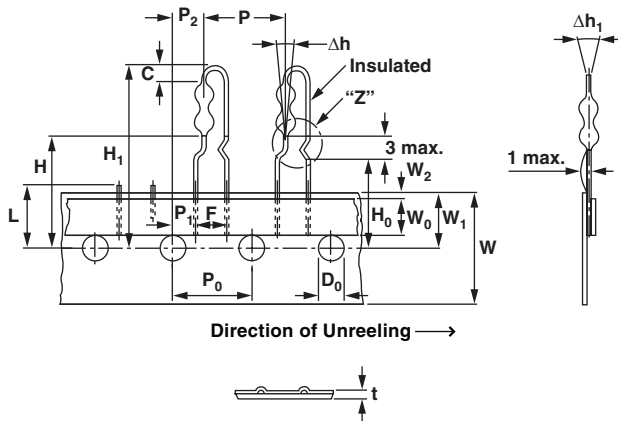
MBB/SMA 0207 WITH RADIAL TAPED ON REEL

LEAD SPACING (UB) 2.5 mm, SIZE 0207



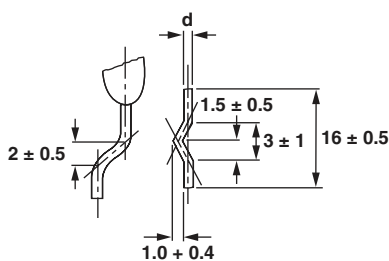
DIMENSIONS [in millimeters]			TOL.
Lead Ø	d	0.6	-
Pitch of components	P	12.7	± 1.0
Pitch of sprocket holes ⁽¹⁾	P ₀	12.7	± 0.3
Distance between hole center and lead center	P ₁	5.1	± 0.7
Distance between hole center and resistor center	P ₂	5.1	± 0.7
Lead Spacing	F	2.5	+ 0.6, - 0.1
Angle of insertion	Δh	1.3 max.	-
Angle of insertion	Δh ₁	2 max.	-
Width of carrier tape	W	18.0	+ 1, - 0.5
Width of adhesive tape	W ₀	6.0	± 0.5
Position of holes	W ₁	9.0	+ 0.75, - 0.5
Position of adhesive tape	W ₂	0.5	+ 0.5, - 0
Body to hole center ⁽²⁾	H	18.0	± 2, - 0
Hole Ø	D ₀	4.0	+ 0.2
Thickness of tape ⁽³⁾	t	0.9 max.	-
Height for cutting	L	11 max.	-
Height for bending	C	2.5	+ 0, - 0.5
Height for insertion	H ₁	32 max.	-

LEAD SPACING (RB) 5.0 mm, SIZE 0207



DIMENSIONS [in millimeters]			TOL.
Lead Ø	d	0.6	-
Pitch of components	P	12.7	± 1.0
Tape pitch	P ₀	12.7	± 0.3
Distance between hole center and lead center	P ₁	3.85	± 0.7
Distance between hole center and resistor center	P ₂	6.35	± 0.7
Lead spacing	F	5.0	+ 0.6, - 0.1
Angle of insertion	Δh	1.3 max.	-
Angle of insertion	Δh ₁	2 max.	-
Width of carrier tape	W	18.0	+ 1, - 0.5
Width of adhesive tape	W ₀	6.0	± 0.5
Position of holes	W ₁	9.0	+ 0.75, - 0.5
Position of adhesive tape	W ₂	0.5	+ 0.5, - 0
Body to hole center ⁽²⁾	H	18.0	+ 2, - 0
Lead crimp to hole center ⁽²⁾	H ₀	16.0	± 0.5
Hole Ø	D ₀	4.0	± 0.2
Thickness of tape ⁽³⁾	t	0.9 max.	-
Height for cutting	L	11 max.	-
Height for bending	C	2.5	+ 0, - 0.5
Height for insertion	H ₁	32 max.	-

Area "Z"



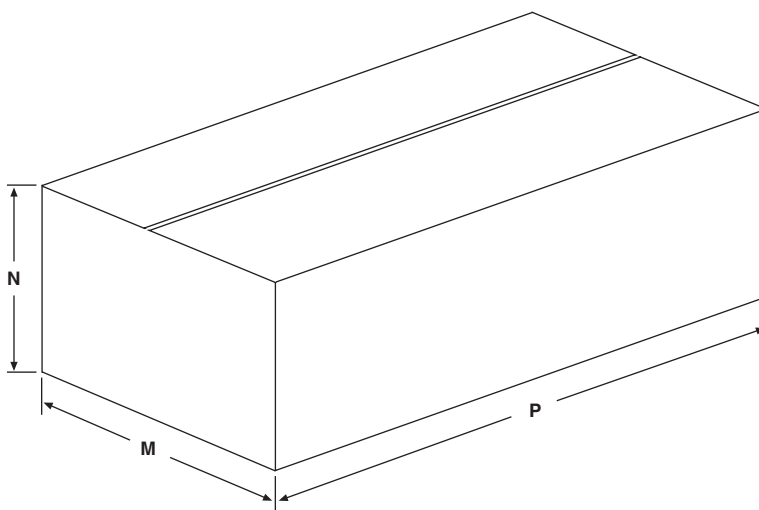
Notes:

- (1) Test over 10 holes - 9 intervals P₀ 12 x 9 = 114.3 ± 0.5
- (2) Parallelism, < 0.5 mm
- (3) Thickness of carrier tape: 0.55 mm ± 0.1

DIMENSIONS OF REEL PACKAGING (RADIAL TAPED)

DIMENSIONS IN MILLIMETERS - resistor type, quantities and dimensions of the packaging for radial taped in reel packaging				
PRODUCT TYPE	QUANTITY	PACKAGING DIMENSIONS		
		REEL		
		Q	V	R
MBB/SMA 0207	4000	355	45	50

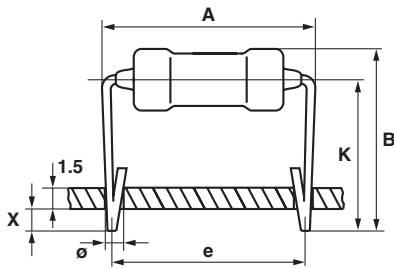
DIMENSIONS OF BOX (FOR LOOSE PACKAGING) in millimeters



Dimensions of box

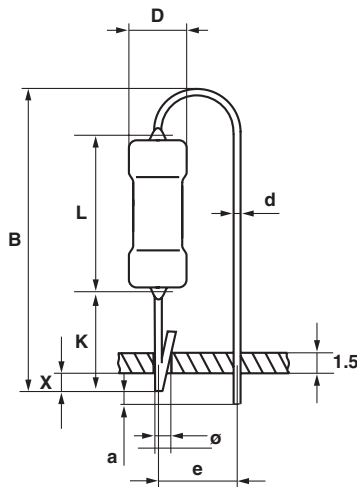
DIMENSIONS in millimeters - resistor type, quantities and dimensions of the packaging in box				
PRODUCT TYPE	QUANTITY	PACKAGING DIMENSIONS		
		LOOSE IN BOX		
		M (mm)	N (mm)	P (mm)
PR01 formed	1000	105	70	205
PR02 formed	500 or 1000	105	70	205
PR03 formed	250 or 500	105	70	205

‘VERSION “S”



“S” VERSION ⁽¹⁾ DIMENSIONS [in millimeters]						
MODEL	A _{max.}	B ± 0.5	E	X	Ø Carrier	ME
0207	9.5	9.5	7.5 ± 0.5	2 +2	1.2	4000
0309	12.5	11.0	10.0 ± 0.5	2 +1.5 -1	1.2	4000
0411	17.0	13.0	15.0 ± 0.5	2 +1.5 -1	1.3	2000
0414	17.0	14.0	15.0 ± 1	2 +1.5 -1	1.3	2000
0617	20.0	15.0	15.0 ± 1	2 +1.5 -1	1.3	1000
0922	27.5	18.5	22.5 ± 1	2 +1.5 -1	1.3	500
0933	37.5	18.5	35.0 ± 1	2 +1.5 -1	1.3	500

VERSION “E”

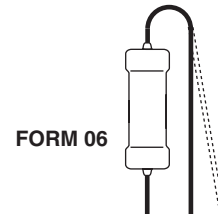
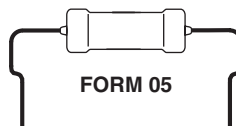
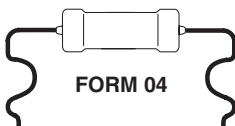
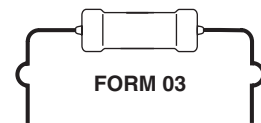
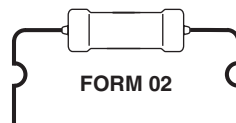
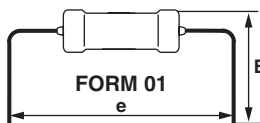


“E” VERSION ⁽¹⁾ DIMENSIONS [in millimeters]							
STYLE TOL.	B ± 0.5	e ± 0.5	a ± 0.5	K _{max.}	X + 1.5	Ø Carrier + 0.1	ME
0207	13.0	2.5	0.5	5.5	2 -0.5	1.3	4000
0309	14.0	2.5	0.5	5.5	2 -0.5	1.3	4000
0411	18.5	5.0	0.5	5.5	2 -1.0	1.3	2000
0414	21.0	5.0	0.5	7.5	2 -1.0	1.3	2000
0617	25.5	5.0	0.5	8.0	2 -1.0	1.3	1000
0922	32.0	7.5	0.5	8.0	2 -1.0	1.3	500

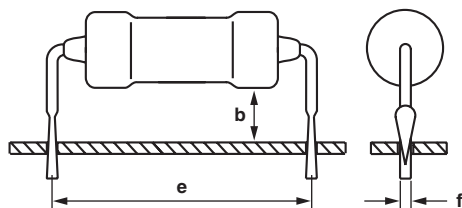
Notes:

⁽¹⁾ D/L/d - see datasheet for each style

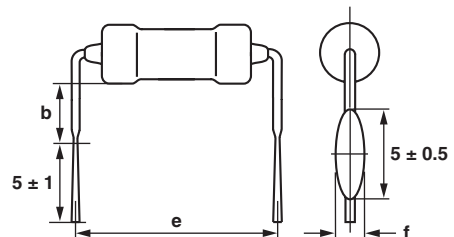
- ME Quantity (bulk packed) per box
- MOQ on request depending on packaging, style and form



VERSION “L”



VERSION “CL1”



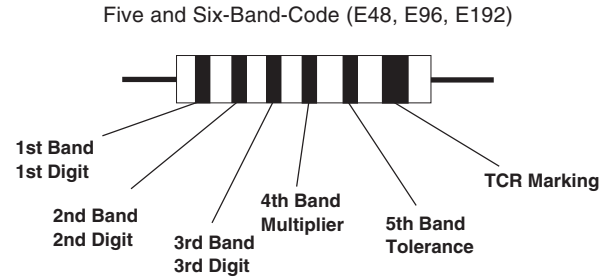
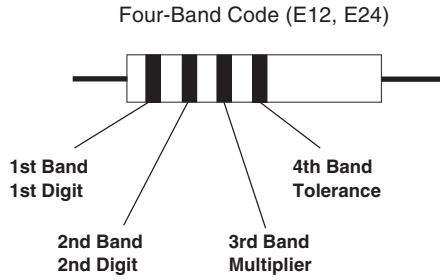
Note:

- Versions “L” and “CL1” styles and dimensions b, e, f on request

Color Code and Standard Resistance Series



Vishay



COLOR CODE				
COLOR	DIGIT	MULTIPLIER	TOLERANCE	TCR 6TH BAND
Without	-	-	± 20 %	
Silver	-	10 ⁻²	± 10 %	
Gold	-	10 ⁻¹	± 5 %	
Black	0	10 ⁰		
Brown	1	10 ¹	± 1 %	100 ⁽¹⁾
Red	2	10 ²	± 2 %	50 ⁽¹⁾
Orange	3	10 ³		15
Yellow	4	10 ⁴		25
Green	5	10 ⁵	± 0.5 %	
Blue	6	10 ⁶	± 0.25 %	10
Violet	7	10 ⁷	± 0.1 %	5
Grey	8	10 ⁸	± 0.05 %	
White	9	10 ⁹		

Note:

⁽¹⁾ Depending on model

STANDARD RESISTANCE SERIES																																	
E24	E48	E96	E192	E24	E48	E96	E192	E24	E48	E96	E192	E24	E48	E96	E192	E24	E48	E96	E192	E24	E48	E96	E192	E24	E48	E96	E192						
100	100	100	100	101	140	140	140	142	196	196	196	198	274	274	274	277	383	383	383	388	536	536	536	542	750	750	750	750					
		102	102	104		143	143	145	200	200	200	203		280	280	284	390	392	392	397		549	549	549	556		768	768	777				
	105	105	105	106		147	147	149	205	205	205	208		287	287	287	291	402	402	402	407	560	562	562	569		787	787	796				
		107	107	109	150		150	152		210	210	213			294	294	298		412	412	417		576	576	583	820		806	806	816			
110	110	110	110	111		154	154	156	220	215	215	215	300	301	301	301	305	430	422	422	422	427	590	590	590	597		825	825	825	835		
		113	113	114	160		158	158	160		221	221	223		309	309	312		432	432	437		604	604	612			845	845	856			
	115	115	115	117		162	162	164		226	226	226	229		316	316	316	320		442	442	442	448	620	619	619	619	626		866	866	876	
120		118	118	120			165	165	167		232	232	234	330		324	324	328		453	453	459		634	634	642			887	887	898		
	121	121	121	123		169	169	172	240	237	237	237	240		332	332	332	336	470	464	464	464	470		649	649	649	657	910	909	909	909	920
		124	124	126			174	174	176		243	243	246		340	340	344		475	475	481		665	665	673			931	931	942			
	127	127	127	129	180	178	178	180		249	249	249	252		348	348	348	352		487	487	487	493	680	681	681	681	690		953	953	965	
130		130	130	132			182	182	184		255	255	258		357	357	361		499	499	505		698	698	706			976	976	988			
	133	133	133	135		187	187	189		261	261	261	264		365	365	365	370	510	511	511	511	517		715	715	715	723					
		137	137	138			191	191	193	270		267	267	271		374	374	379		523	523	530		732	732	741							



Standard Electronic Decade Value Tables

STANDARD DECADE RESISTANCE VALUES													
<p>The following table lists four established number series which are used as preferred values in electronic design. Each series is shown under an associated value of tolerance %. The number series under the $\pm 10\%$ column is known as the E12 Series because there are 12 standard values within a decade range. $\pm 2\%$ and $\pm 5\%$ utilize the E24 Series, $\pm 1\%$ uses E96 and $\pm 0.1\%$, $\pm 0.25\%$ and $\pm 0.5\%$ use E192. Successive values within a decade series are related (approximately) by a factor of $\sqrt[12]{10}$ for the E12 Series, $\sqrt[24]{10}$ for the E24 Series, $\sqrt[96]{10}$ for the E96 Series and $\sqrt[192]{10}$ for the E192 Series.</p> <p>Use of standard values is encouraged because stocking programs are designed around them. However, intermediate values can be special ordered where permitted. Consult factory.</p>													
$\pm 0.1\%$ $\pm 0.25\%$ $\pm 0.5\%$		$\pm 0.1\%$ $\pm 0.25\%$ $\pm 0.5\%$		$\pm 0.1\%$ $\pm 0.25\%$ $\pm 0.5\%$		$\pm 0.1\%$ $\pm 0.25\%$ $\pm 0.5\%$		$\pm 0.1\%$ $\pm 0.25\%$ $\pm 0.5\%$		$\pm 0.1\%$ $\pm 0.25\%$ $\pm 0.5\%$		$\pm 2\%$ $\pm 5\%$ $\pm 10\%$	
$\pm 1\%$		$\pm 1\%$		$\pm 1\%$		$\pm 1\%$		$\pm 1\%$		$\pm 1\%$			
10.0	10.0	14.7	14.7	21.5	21.5	31.6	31.6	46.4	46.4	68.1	68.1	10	10
10.1		14.9		21.8		32.0		47.0		69.0		11	-
10.2	10.2	15.0	15.0	22.1	22.1	32.4	32.4	47.5	47.5	69.8	69.8	12	12
10.4		15.2		22.3		32.8		48.1		70.6		13	-
10.5	10.5	15.4	15.4	22.6	22.6	33.2	33.2	48.7	48.7	71.5	71.5	15	15
10.6		15.6		22.9		33.6		49.3		72.3		16	-
10.7	10.7	15.8	15.8	23.2	23.2	34.0	34.0	49.9	49.9	73.2	73.2	18	18
10.9		16.0		23.4		34.4		50.5		74.1		20	-
11.0	11.0	16.2	16.2	23.7	23.7	34.8	34.8	51.1	51.1	75.0	75.0	22	22
11.1		16.4		24.0		35.2		51.7		75.9		24	-
11.3	11.3	16.5	16.5	24.3	24.3	35.7	35.7	52.3	52.3	76.8	76.8	27	27
11.4		16.7		24.6		36.1		53.0		77.7		30	-
11.5	11.5	16.9	16.9	24.9	24.9	36.5	36.5	53.6	53.6	78.7	78.7	33	33
11.7		17.2		25.2		37.0		54.2		79.6		36	-
11.8	11.8	17.4	17.4	25.5	25.5	37.4	37.4	54.9	54.9	80.6	80.6	39	39
12.0		17.6		25.8		37.9		55.6		81.6		43	-
12.1	12.1	17.8	17.8	26.1	26.1	38.3	38.3	56.2	56.2	82.5	82.5	47	47
12.3		18.0		26.4		38.8		56.9		83.5		51	-
12.4	12.4	18.2	18.2	26.7	26.7	39.2	39.2	57.6	57.6	84.5	84.5	56	56
12.6		18.4		27.1		39.7		58.3		85.6		62	-
12.7	12.7	18.7	18.7	27.4	27.4	40.2	40.2	59.0	59.0	86.6	86.6	68	68
12.9		18.9		27.7		40.7		59.7		87.6		75	-
13.0	13.0	19.1	19.1	28.0	28.0	41.2	41.2	60.4	60.4	88.7	88.7	82	82
13.2		19.3		28.4		41.7		61.2		89.8		91	-
13.3	13.3	19.6	19.6	28.7	28.7	42.2	42.2	61.9	61.9	90.9	90.9		
13.5		19.8		29.1		42.7		62.6		92.0			
13.7	13.7	20.0	20.0	29.4	29.4	43.2	43.2	63.4	63.4	93.1	93.1		
13.8		20.3		29.8		43.7		64.2		94.2			
14.0	14.0	20.5	20.5	30.1	30.1	44.2	44.2	64.9	64.9	95.3	95.3		
14.2		20.8		30.5		44.8		65.7		96.5			
14.3	14.3	21.0	21.0	30.9	30.9	45.3	45.3	66.5	66.5	97.6	97.6		
14.5		21.3		31.2		45.9		67.3		98.8			

Note:

- Standard resistance values are obtained from the decade table by multiplying by powers of 10. As an example, 13.3 can represent Ω , 133 Ω , 1.33 k Ω , 13.3 k Ω , 133 k Ω , 1.33 M Ω .



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