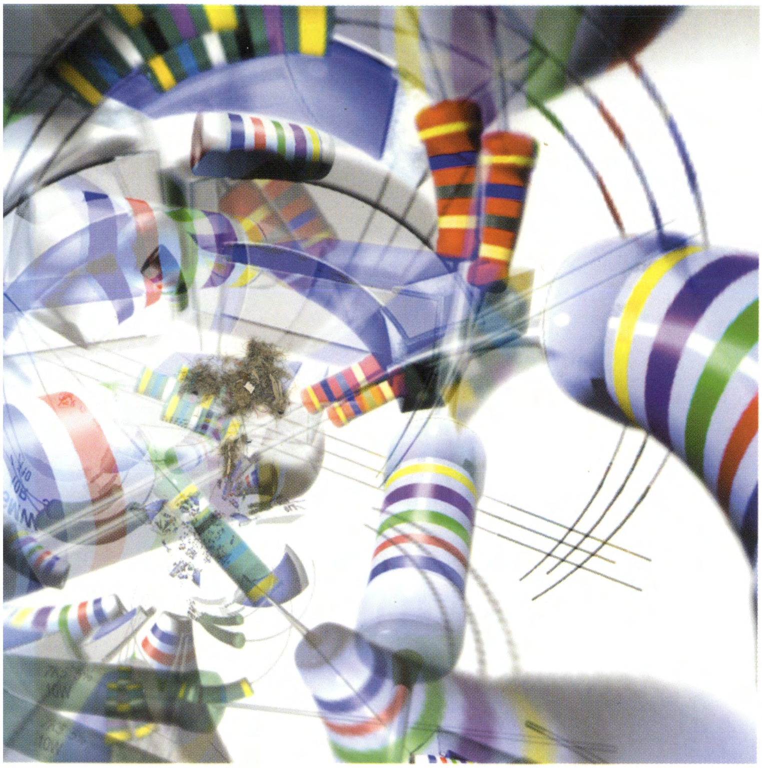


Linear Resistors

Data Handbook BC08
2001/2002

COMPONENTS

PROVIDING KNOWLEDGE. CREATING SOLUTIONS.

Welcome to the BCcomponents' Linear Resistor Data Handbook. The wide range of our resistor programme covers all resistor technologies and reflects our strong commitment to this important area of the passive-component market.

QUALITY ASSURED

Although the initial cost of resistors is generally low, the large numbers used in a typical circuit means that their reliability is of ultimate importance. Component reliability is, therefore, our prime consideration and quality our main commitment. A commitment which extends into all aspects of our business from the design and manufacturing process, to the supply and service we offer to customers. Our resistor facilities in Roermond - The Netherlands and Heide - Germany are ISO 9001 and QS 9000 certified suppliers who are supported by means of statistical process control (SPC) procedures at all key points in the production process.

CUSTOMER SERVICE

BCcomponents has a network of sales organizations that communicate directly with the regional Business Centre for fixed resistors. Short communication lines mean fast response to all customer enquiries and rapid problem solving.

ADVANCED RESISTOR TECHNOLOGIES

Our lresistors are made using thin and thick-film technologies. And, responding to market trends for miniaturization and high-accuracy, we have a strong programme of application specific resistors. The range is divided into two categories:

- **Film resistors.** For all general purpose consumer, professional and industrial equipment. They are subdivided into thin-film, metal-glaze and fusible metal-film resistors.
- **Application specific resistors.** For applications demanding the ultimate in accuracy or operation in extreme environments. These hi-rel types include SMD and leaded devices for precision, low-ohmic, high-ohmic, high voltage and power applications.

We hope you'll find this Data Handbook useful and easy to use. If you can't find the resistor you want, need more information or require a special selection, please call your nearest sales office. You'll find their address on the back cover of this book.

Linear Resistors

CONTENTS

DEFINITIONS

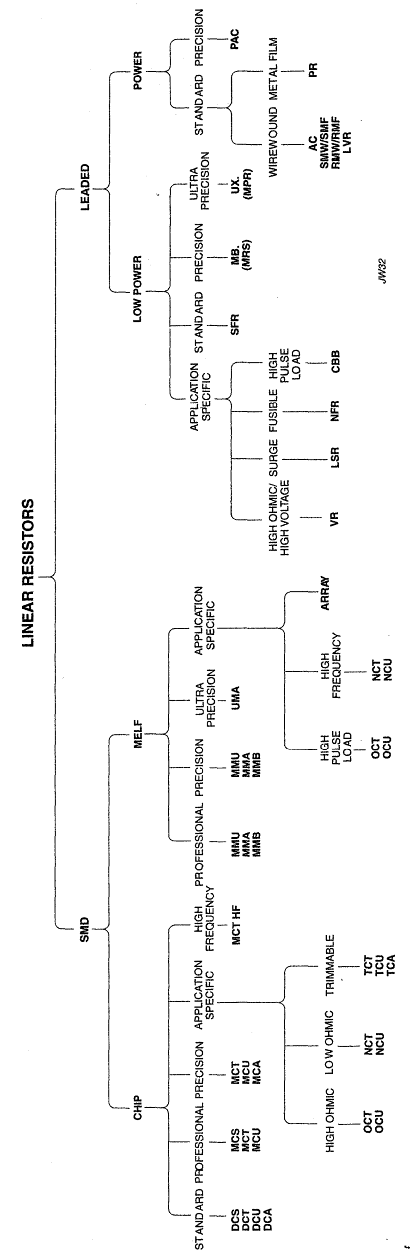
Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Customers of BCcomponents who are using or selling these products for use in such applications do so at their own risk and agree to fully indemnify BCcomponents for any damages resulting from such improper use or sale.

Linear resistors

Resistor programme



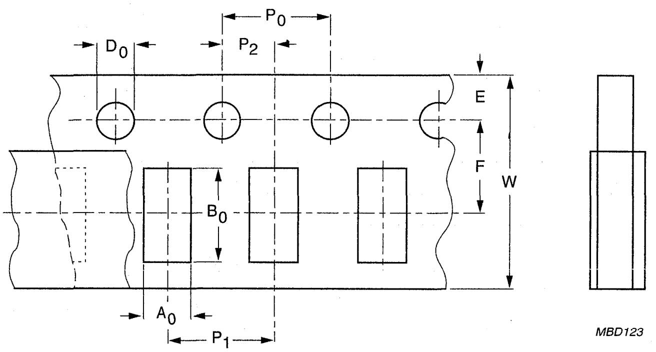
Linear chip and MELF resistors — Selection guide

APPLICATION	TYPE	TOLERANCE (%)	RESISTANCE RANGE	DISSIPATION at °C	DISSIPATION W	PAGE
CHIP resistors						
THICK FILM						
Standard	DCS 0402	±5	10 Ω to 1 MΩ	70	0.063	12
	DCT 0603	±1; ±5	1 Ω to 10 MΩ		0.063	
	DCU 0805		1 Ω to 10 MΩ		0.125	
	DCA 1206		1 Ω to 10 MΩ		0.25	
THIN FILM						
Professional	MCS 0402	±0.5; ±1	10 Ω to 4.99 MΩ	70	0.063	21
	MCT 0603		1 Ω to 10 MΩ		0.1	
	MCU 0805	±0.5	10 Ω to 221 kΩ		0.125	
Precision	MCT 0603	±0.1; ±0.25	47 Ω to 150 kΩ	70	0.1	34
	MCU 0805		47 Ω to 221 kΩ		0.125	
	MCA 1206		47 Ω to 332 kΩ		0.125	
High ohmic	OCT 0603	±5	11 MΩ to 130 MΩ	70	limited by U_{max}	44
	OCU 0805					
Low ohmic	NCT 0603	±5	0.22 Ω to 0.91 Ω	70	0.1	51
	NCU 0805				0.125	
Trimmable	TCT 0603	+0/−10; +0/−20; +0/−30	10 Ω to 1 MΩ	70	0.1	59
	TCU 0805				0.125	
	TCA 1206	+0/−20			0.25	
High frequency	MCT 0603 HF	±2	6.8 Ω to 470 Ω; 50 Ω	70	0.125	69
MELF resistors						
THIN FILM						
Professional	MMU 0102	±0.5; ±1; ±2; ±5	0.22 Ω to 2.21 MΩ	70	0.2	80
	MMA 0204		0.22 Ω to 10 MΩ		0.25	
	MMB 0207		0.1 Ω to 8.2 MΩ		0.4	
Precision	MMU 0102	±0.1; ±0.25; ±0.5	100 Ω to 221 kΩ	70	0.2	95
	MMA 0204		10 Ω to 332 kΩ		0.25	
	MMB 0207	±0.25; ±0.1	15 Ω to 1 MΩ		0.4	
Ultra precision	UMA 0204	±0.25; ±0.1; ±0.05; ±0.02	22 Ω to 221 kΩ	70	0.07	106
APPLICATION SPECIFIC						
High pulse load	CMA 0204	±2	10 Ω to 100 kΩ	70	0.25	117
High frequency	MMU 0102 HF	±2	6.8 Ω to 470 Ω	70	0.2	129
	MMA 0204 HF	±1	1.5 Ω to 475 Ω		0.25	
	MMB 0207 HF	±2	6.8 Ω to 470 Ω		0.4	

TAPE AND REEL

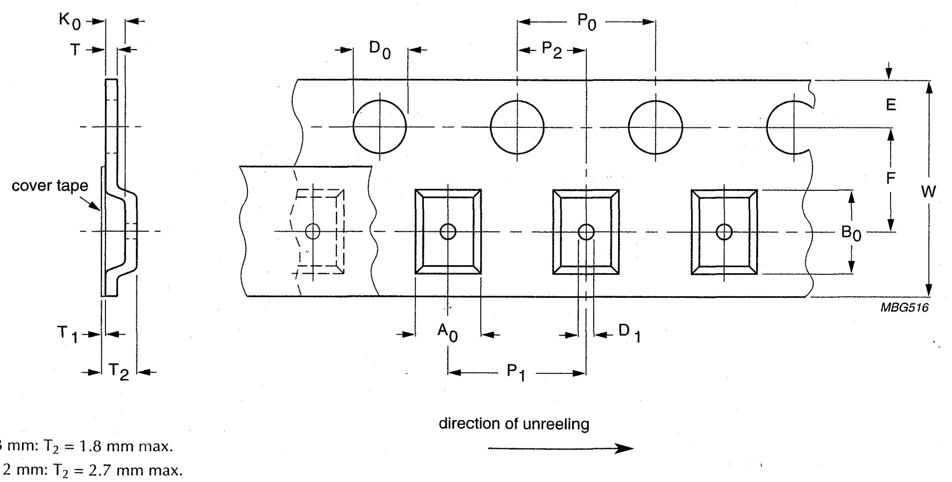
All tape and reel specifications are in accordance with the second edition of *"IEC 60286-3, JIS-C-0806 and EIA-481-1"*. Basic dimensions are given in Figs 1, 2, 3, 4 and Tables 1 and 2.

Cardboard and blister tape



For dimensions see Table 1.
Carrier tape thickness:
0.43 ±0.05 mm (0402)
0.6 ±0.05 mm (0603; 0805)
0.75 ±0.05 mm (1206).

Fig.1 Cardboard tape.



For W = 8 mm: T_2 = 1.8 mm max.
For W = 12 mm: T_2 = 2.7 mm max.
For dimensions see Table 1.

Fig.2 Blister tape.

Linear SMD Chip and MELF resistors — Packaging

Table 1 Dimensions of cardboard and blister tape for relevant chip size; see Figs 1 and 2

SYMBOL	CARDBOARD TAPE (IEC 60286-3, TYPE I)				BLISTER TAPE (IEC 60286-3, TYPE II)			UNIT
	PRODUCT SIZE CODE FLAT CHIP				PRODUCT SIZE CODE MELF			
	0402	0603	0805	1206	0102	0204	0207	
A_0	0.7	1.1	1.6	1.9	1.3 +0/−0.05	1.55 ±0.1	2.4 ±0.1	mm
B_0	1.2	1.9	2.38	3.5	2.45 +0.5/−0	3.7 ±0.1	6.0 ±0.1	mm
P_1	2.0	4.0 ±0.1						mm
P_2	2.0 ±0.05							mm
P_0	4.0 ±0.1							mm
D_0	1.5 +0.1/−0							mm
E	1.75 ±0.1							mm
F	3.5 ±0.05						5.5 ±0.05	mm
W	8.0 ±0.3						12.0 ±0.3	mm

Leader/trailer tape specification

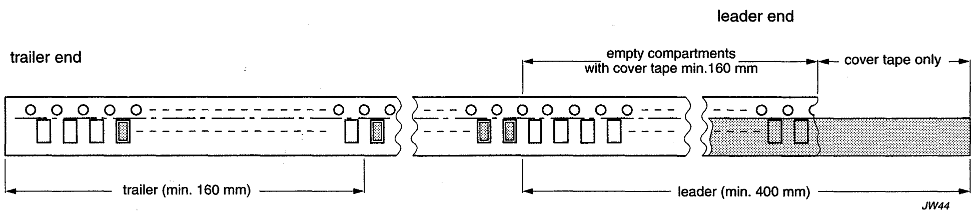


Fig.3 Leader/trailer tape.

The minimum length of the leader is 400 mm, which includes a minimum 160 mm of carrier tape with empty compartments and sealed by the cover tape.
The minimum length of the trailer is 160 mm carrier tape with empty compartments and sealed by the cover tape.

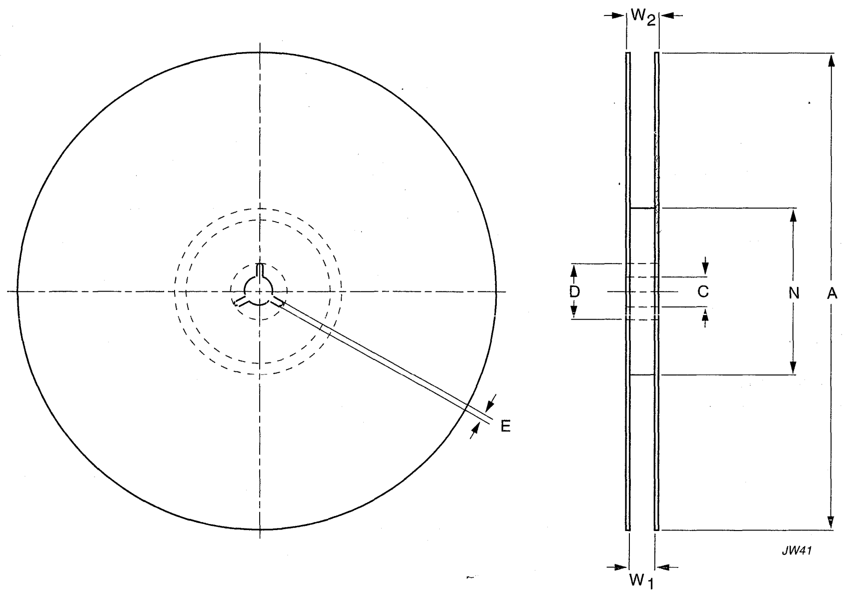
PEEL-OFF FORCE

Peel-off forces are 0.1 N to 1.0 N for 8 mm tape and 0.1 N to 1.3 N for 12 mm tape at a peel-off speed of 300 ±10 mm/minute. The peel-off angle should be between 165° and 180°.

Environmental considerations

- Cover tape, carrier tape and reel do not contain environmentally-harmful PVC materials.
- Because the carrier tape is made of either paper (paper tape) or polycarbonate (blister tape) and the reel is polystyrene, they are ideally suited for recycling.
- The reels can be reused if returned to the factory.
- Tape and reel are antistatic.

Reel specification



For reel dimensions see Table 2.

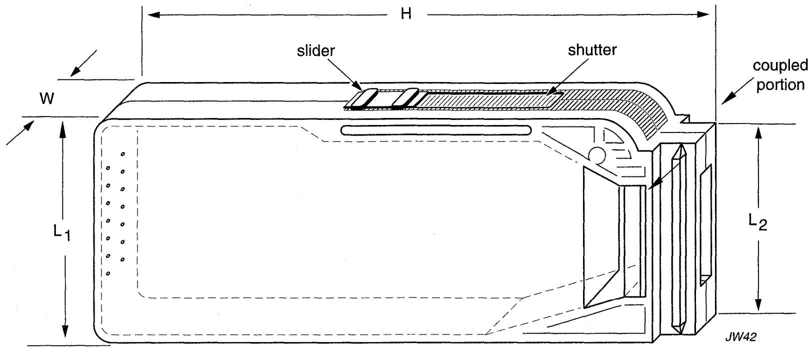
Fig.4 Reel.

Table 2 Packaging codes, quantities and reel dimensions in millimetres; see Fig.4

DESCRIPTION	VALUE								
Packaging code	**P1**	**B1**	**BL**	**P5**	**E0**	**B0**	**PW**	**B2**	**B7**
Units per reel	**1000**	**1000**	**3000**	**5000**	**10000**	**10000**	**20000**	**2000**	**7000**
A	180					330		180	330
W_1	8.4 +1.5/0							12.4 +1.5/0	
$W_{2\,max}$	14.4							18.4	
E	2.5 ±0.5								
D	22.5 ±2.0								
C	13.0 +0.5/−0.25								
N	62								

BULK CASE SPECIFICATION

The bulk case specification is in accordance with *"IEC 60286-6"*.



For dimensions see Table 3.

Fig.5 Bulk case outline.

Table 3 Packaging codes, quantities and bulk case dimensions in millimetres; see Fig.5

DESCRIPTION	VALUE	
Packaging code	**M3**	**M8**
Units per reel	**3000**	**8000**
L_1	36	
L_2	31.5	
W	12	
H	110	

CHIP RESISTOR PRODUCT DATA

Thick film flat chip resistors

DCS 0402; DCT 0603; DCU 0805; DCA 1206

FEATURES

- State of the art thick film technology
- Improved termination design
- Standard TC: ±100 and ±200 ppm/K
- Tight tolerance available: ±1%
- Sizes:
  - Imperial: 0402; 0603; 0805; 1206
  - Metric: RR 1005M; RR 1608M; RR 2012M; RR 3216M

APPLICATIONS

- All general purpose applications
- Office automation equipment
- Consumer electronics.

DESCRIPTION

DCS 0402, DCT 0603, DCU 0805 and DCA 1206 thick film chip resistors are made for all general purpose applications. They are typically used in the production of office automation equipment and consumer electronics.

The production is performed in a mass volume production site. A thick film is screen printed on a high grade alumina ceramic substrate to form the resistive layer. Pre-contacts are printed on both sides of the substrate. The resistors are laser trimmed to the target value. The resistor elements are covered by glass and a protective coating combined for superior electrical, mechanical and climatic protection. The prepared terminations receive an electroplating of PbSn solder on nickel plating. A three or four digit code designates the nominal resistance value.

The result of the determined production is verified by a final test performed on 100% of the individual chip resistors. Only accepted products are laid directly into the paper tape according to **IEC 60286-3**.

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with**EN 140000 (IEC 60115-1)** and **EN 140400 (IEC 60115-8)**.

This product family of thick film flat chip resistors is completed by **Zero Ohm Jumpers**.

QUICK REFERENCE DATA

DESCRIPTION	DCS 0402	DCT 0603	DCU 0805	DCA 1206
Metric size	RR 1005M	RR 1608M	RR 2012M	RR 3216M
Resistance range	10 Ω to 1 MΩ	1 Ω to 10 MΩ	1 Ω to 10 MΩ	1 Ω to 10 MΩ
Resistance tolerance	±5%	±5%; ±1%		
Temperature coefficient	±200 ppm/K	±200 ppm/K; ±100 ppm/K		
Operation mode	standard	standard	standard	standard
Climatic category (LCT/UCT/days)	55/125/56	55/125/56	55/125/56	55/125/56
Rated dissipation, P_{70}	0,063 W	0,063 W	0,125 W	0,25 W
Operating voltage, U_{max} AC/DC	50 V	50 V	150 V	200 V
Film temperature	125 °C	125 °C	125 °C	125 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	10 Ω to 1 MΩ	1 Ω to 10 MΩ	1 Ω to 10 MΩ	1 Ω to 10 MΩ
1 000 h	≤ 3%	≤ 1,5%	≤ 1,5%	≤ 1,5%
8 000 h	≤ 6%	≤ 3%	≤ 3%	≤ 3%
Specified lifetime	8000 h	8000 h	8000 h	8000 h
Permissible voltage against ambient:				
1 minute	75 V	150 V	150 V	200 V
continuous	75 V	75 V	75 V	75 V

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[1]			
T.C.	**TOLERANCE**	**DCS 0402**	**DCT 0603**	**DCU 0805**	**DCA 1206**
±200 ppm/K	±5%	**10 Ω to 1 MΩ**	**1 Ω to 10 MΩ**	**1 Ω to 10 MΩ**	**1 Ω to 10 MΩ**
±100 ppm/K	±1%	–	**10 Ω to 1 MΩ**	**10 Ω to 1 MΩ**	**10 Ω to 1 MΩ**
Jumper	–	**≤ 50 mΩ;** I_{max} **= 0,8 A**	**≤ 50 mΩ;** I_{max} **= 0,8 A**	**≤ 50 mΩ;** I_{max} **= 1,1 A**	**≤ 50 mΩ;** I_{max} **= 1,6 A**

Note

1. Resistance value to be selected from E24 series for ±5% tolerance and from E24/E96 series for ±1% tolerance.

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312		
			CARDBOARD TAPE ON REEL		
TYPE	T.C.	TOL.	PA 5000 units	E0 10000 units	PW 20000 units
DCS 0402	±200 ppm/K	±5%	–	**364 1....**	–
	jumper	–	–	**364 90001**	–
DCT 0603	±200 ppm/K	±5%	304 1....	–	**309 1....**
	±100 ppm/K	±1%	304 7....	–	**309 7....**
	jumper	–	304 90001	–	**309 90001**
DCU 0805	±200 ppm/K	±5%	324 1....	–	**329 1....**
	±100 ppm/K	±1%	324 7....	–	**329 7....**
	jumper	–	324 90001	–	**329 90001**
DCA 1206	±200 ppm/K	±5%	344 1....	–	**349 1....**
	±100 ppm/K	±1%	344 7....	–	**349 7....**
	jumper	–	344 90001	–	**349 90001**

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

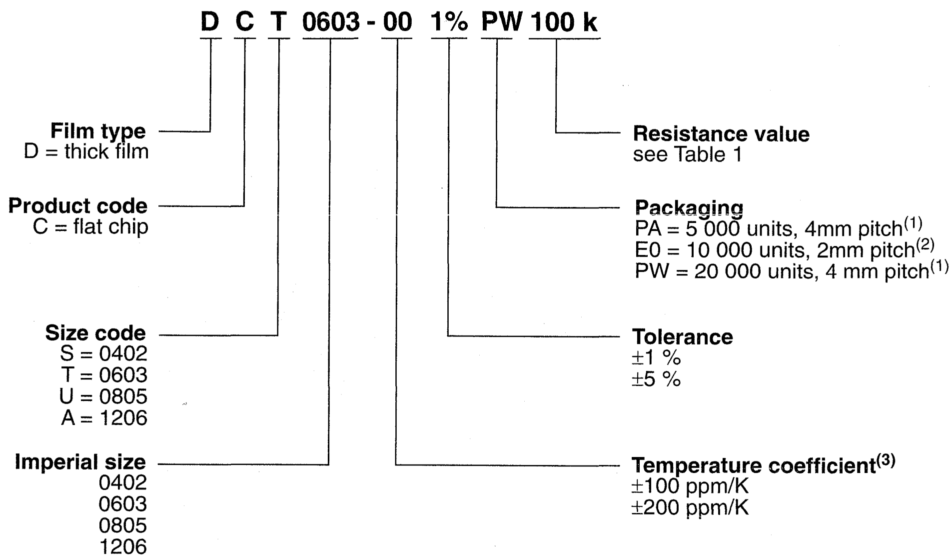
RESISTANCE DECADE	LAST DIGIT
1 to 9,99 Ω	8
10 to 99,9 Ω	9
100 to 999 Ω	1
1 kΩ to 9,99 kΩ	2
10 kΩ to 99,9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9,99 MΩ	5
10 MΩ to 99,9 MΩ	6

ORDERING EXAMPLE

The ordering code of a DCT 0603 resistor, value 100 kΩ and TC 100 with ±1% tolerance, supplied in cardboard tape of 20000 units per reel is: 2312 309 71004.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



(1) PA and PW only for DCT 0603; DCU 0805 and DCA 1206.
(2) E0 only for DCS 0402.
(3) A temperature coefficient ±100 ppm/K is marked -00, higher T.C. values are not identified.

FUNCTIONAL DESCRIPTION

Derating

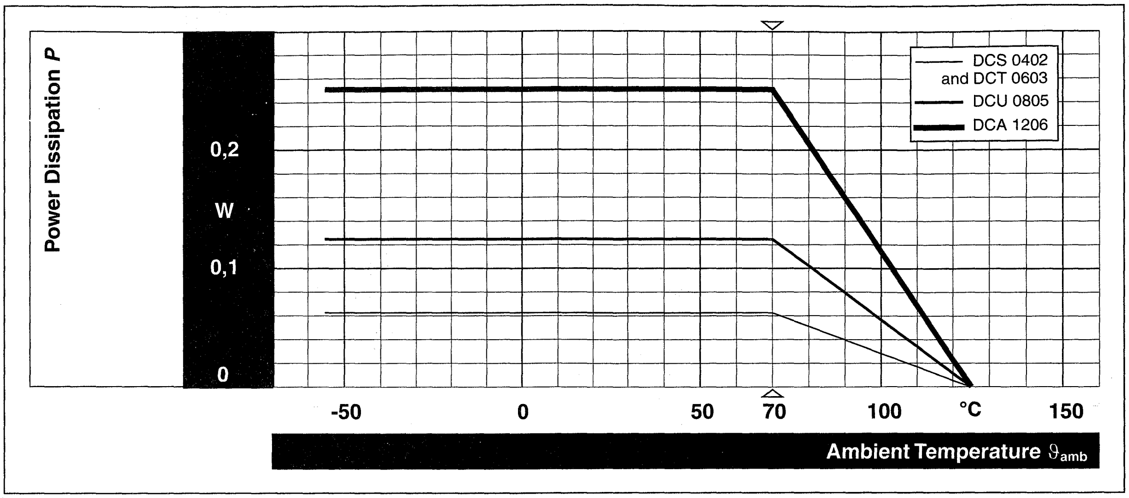


Fig.1 Derating, standard operation.

Current noise

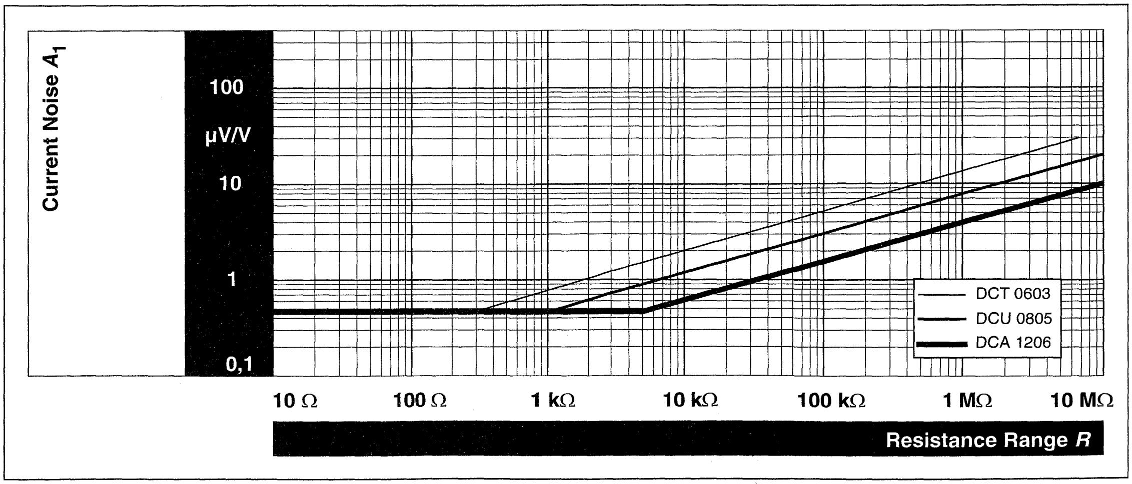
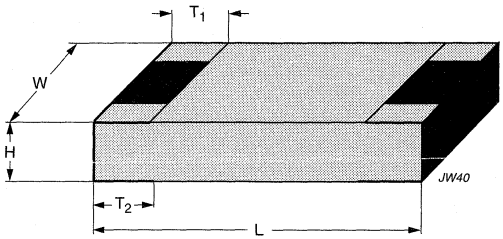


Fig.2 Current noise A_1 in accordance with IEC 60195.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.3 Outlines.

Table 4 Chip resistor types, mass and relevant physical dimensions; see Fig.3

TYPE	H (mm)	L (mm)	W (mm)	T_1 (mm)	T_2 (mm)	MASS (mg)
DCS 0402	0,35 ±0,05	1,0 ±0,05	0,5 ±0,05	0,2 +0,15/–0,1	0,25 ±0,1	0,58
DCS 0603	0,45 ±0,1	1,6 ±0,1	0,85 ±0,1	0,3 ±0,2	0,3 ±0,2	2,5
DCS 0805	0,55 ±0,1	2,0 ±0,15	1,25 ±0,15	0,4 ±0,2	0,4 ±0,2	5,5
DCS 1206	0,55 ±0,1	3,15 ±0,15	1,6 ±0,15	0,5 ±0,25	0,5 ±0,25	10,0

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 140400 / IEC 60115-1, Sectional specification (includes schedule for qualification approval)

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 1 060 mbar).

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

In Table Fig.5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)		
			stability for product types:			
			DCS 0402	–	–	≤ 1 MΩ
			DCT 0603	≤ 1 MΩ	> 1 MΩ	–
			DCU 0805	≤ 1 MΩ	> 1 MΩ	–
			DCA 1206	≤ 1 MΩ	> 1 MΩ	–
4.5	–	resistance		±1%; ±5%		
4.8.4.2	–	temperature coefficient	at 20 / LCT / 20 °C and 20 / UCT / 20 °C	±200 ppm/K; ±100 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; 1 000 h	±(1,5% + 0,1 Ω)	±(3% + 0,1 Ω)	±(3% + 0,1 Ω)
4.25.3	–	endurance at upper category temperature	125 °C; 1 000 h	±(1,5% + 0,1 Ω)	±(3% + 0,1 Ω)	±(3% + 0,1 Ω)
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±(1,5% + 0,1 Ω)	±(3% + 0,1 Ω)	±(3% + 0,1 Ω)

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)		
			stability for product types:			
			DCS 0402	–	–	≤ 1 MΩ
			DCT 0603	≤ 1 MΩ	> 1 MΩ	–
			DCU 0805	≤ 1 MΩ	> 1 MΩ	–
			DCA 1206	≤ 1 MΩ	> 1 MΩ	–
4.23		climatic sequence:				
4.23.2	2 (Ba)	dry heat	125 °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 to 35 °C			
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	±(1,5% + 0,1 Ω) no visible damage	±(3% + 0,1 Ω) no visible damage	±(1% + 0,1 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	±(1% + 0,05 Ω) no visible damage	±(1% + 0,05 Ω) no visible damage	±(2% + 0,1 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±(0,5% + 0,05 Ω) no visible damage	±(0,5% + 0,05 Ω) no visible damage	±(2% + 0,1 Ω) 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 ±5 °C; 10 ±1 s	±(0,5% + 0,05 Ω) no visible damage	±(0,5% + 0,05 Ω) no visible damage	±(1% + 0,1 Ω) no visible damage
4.17.2	20 (Ta)	solderability	+215 °C; 3 s solder bath method	good tinning (≥95% covered); no visible damage		
4.32	21 (Ue3)	shear (adhesion)	5 N; 10 s	no visible damage		
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown		

Professional flat chip resistors MCS 0402; MCT 0603; MCU 0805

FEATURES

- Advanced thin film technology
- Advanced dissipation rating: 100 mW for 0603
- Excellent overall stability: Class 0,5
- Case sizes:
  - Imperial: 0402; 0603; 0805.
  - Metric: RR 1005M; RR 1608M; RR 2012M.

APPLICATIONS

- Telecommunication
- Medical equipment
- Industrial equipment.

DESCRIPTION

MCS 0402, MCT 0603 and MCU 0805 Professional Thin Film Flat Chip Resistors are the perfect choice for most fields of modern professional electronics where reliability and stability is of major concern. Typical applications include telecommunication, medical equipment and high-end computer and audio/video electronics.

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal alloy is deposited on a super high grade (96% Al_2O_3) ceramic substrate and conditioned to achieve the desired temperature coefficient. Specially designed inner contacts are deposited on both sides. A special laser is used to achieve the target value by smoothly cutting a meander groove in the resistive layer without damaging the ceramics. For the high ohmic range, optimized Cermet products provide comparable properties.

The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100% of the individual chip resistors. Only accepted products are laid directly into the paper tape in accordance with **IEC 60286-3**.

The resistors are suitable for processing on automatic SMD assembly systems and for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with **CECC 40 401-801** which refers to **EN 140000** **(IEC 60115-1)** and **EN 140400 (IEC 60115-8)**.

BCcomponents 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 BCcomponents BEYSCHLAG manufacturing process.

This product family of thin film flat chip resistors is completed by **Zero Ohm Jumpers**.

On request, resistors are available with established reliability in accordance with **CECC 40 401-803 Version E**.

Professional flat chip resistors MCS 0402; MCT 0603; MCU 0805

QUICK REFERENCE DATA

DESCRIPTION	MCS 0402		MCT 0603		MCU 0805	
Metric size	RR 1005M		RR 1608M		RR 2012M	
Resistance range	10 Ω to 4,99 MΩ		1 Ω to 10 MΩ		10 Ω to 221 kΩ	
Resistance tolerance	±1%; ±0,5%					
Temperature coefficient	±50 ppm/K; ±25 ppm/K					
Operation mode	standard	power	standard	power	standard	power
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}	0,063 W	0,1 W	0,1 W	0,125 W	0,125 W	0,2 W
Operating voltage, U_{max} AC/DC	50 V		75 V		150 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:	10 Ω to 33,2 kΩ		10 Ω to 100 kΩ		10 Ω to 221 kΩ	
1 000 h	≤ 0,25%	≤ 0,5%	≤ 0,25%	≤ 0,5%	≤ 0,25%	≤ 0,5%
8 000 h	≤ 0,5%	≤ 1,0%	≤ 0,5%	≤ 1,0%	≤ 0,5%	≤ 1,0%
225 000 h	≤ 1,5%		≤ 1,5%		≤ 1,5%	
Specified lifetime	225 000 h	8 000 h	225 000 h	8 000 h	225 000 h	8 000 h
Permissible voltage against ambient :						
1 minute	75 V		100 V		200 V	
continuous	75 V		75 V		75 V	
Failure rate	$\leq 2 \times 10^{-9}$/h		$\leq 2 \times 10^{-9}$/h		$\leq 2 \times 10^{-9}$/h	

Professional flat chip resistors MCS 0402; MCT 0603; MCU 0805

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[1]		
T.C.	**TOLERANCE**	**MCS 0402**	**MCT 0603**	**MCU 0805**
±50 ppm/K	±1%	**10 Ω to 4,99 MΩ**	**1 Ω to 10 MΩ**	–
	±0,5%	100 Ω to 100 kΩ	47 Ω to 221 kΩ	–
±25 ppm/K	±0,5%	**100 Ω to 100 kΩ**	**47 Ω to 221 kΩ**	10 Ω to 221 kΩ
Jumper		**≤ 20 mΩ; I_{max} = 0,63 A**	**≤ 20 mΩ; I_{max} = 1 A**	≤ 20 mΩ; I_{max} = 1 A

Note

1. Resistance values to be selected from E96 (preferred) or E24 series.

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Professional flat chip resistors MCS 0402; MCT 0603; MCU 0805

ORDERING INFORMATION

Components may be ordered by using either a simple clear text code; see "Type description and ordering code" or BCcomponents' unique 12NC.

Numeric ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312 ... . CARDBOARD TAPE ON REEL		
TYPE	T.C.	TOL.	P5 5000 units	E0 20000 units	PW 20000 units
MCS 0402	±50 ppm/K	±1%	–	**275 1....**	–
		±0,5%	–	275 5....	–
	±25 ppm/K	±0,5%	–	**276 5....**	–
	jumper	–	–	**275 90001**	–
MCT 0603	±50 ppm/K	±1%	**215 1....**	–	**205 1....**
		±0,5%	215 5....	–	205 5....
	±25 ppm/K	±0,5%	**216 5....**	–	**206 5....**
	jumper	–	**215 90001**	–	**205 90001**
MCU 0805	±25 ppm/K	±0,5%	256 5....	–	246 5....
	jumper	–	255 90001	–	245 90001

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

RESISTANCE DECADE	LAST DIGIT
1 to 9,99 Ω	8
10 to 99,9 Ω	9
100 to 999 Ω	1
1 to 9,99 kΩ	2
10 to 99,9 kΩ	3
100 to 999 kΩ	4
1 to 9,99 MΩ	5

ORDERING EXAMPLE

The ordering code of a MCT 0603 resistor, value 47 kΩ and TC 50 with ±1% tolerance, supplied in cardboard tape of 5000 units per reel is: 2312 215 14703.

Professional flat chip resistors MCS 0402; MCT 0603; MCU 0805

Type description and ordering code

- We recommend to use a clear text ordering code to minimize the risk of errors in order handling.

M C T 0603 - 50 1% P5 47 k

Film type
M = metal film or cermet

Product code
C = flat chip

Size code
S = 0402
T = 0603
U = 0805

Imperial size
0402
0603
0805

Resistance value
see Table 1

Packaging
P5 = 5 000 units, 4 mm pitch(1)
E0 = 10 000 units, 2 mm pitch(2)
PW = 20 000 units, 4 mm pitch(1)

Tolerance
±1 %
±0,5 %

Temperature Coefficient
±25 ppm/K
±50 ppm/K

Jumpers are ordered by the resistance value 0 Ω, e.g. MCT 0603 P5 0R0.

(1) P5 and PW only for MCT 0603 and MCU 0805.
(2) E0 only for MCS 0402.

Professional flat chip resistors MCS 0402; MCT 0603; MCU 0805

FUNCTIONAL DESCRIPTION

Derating

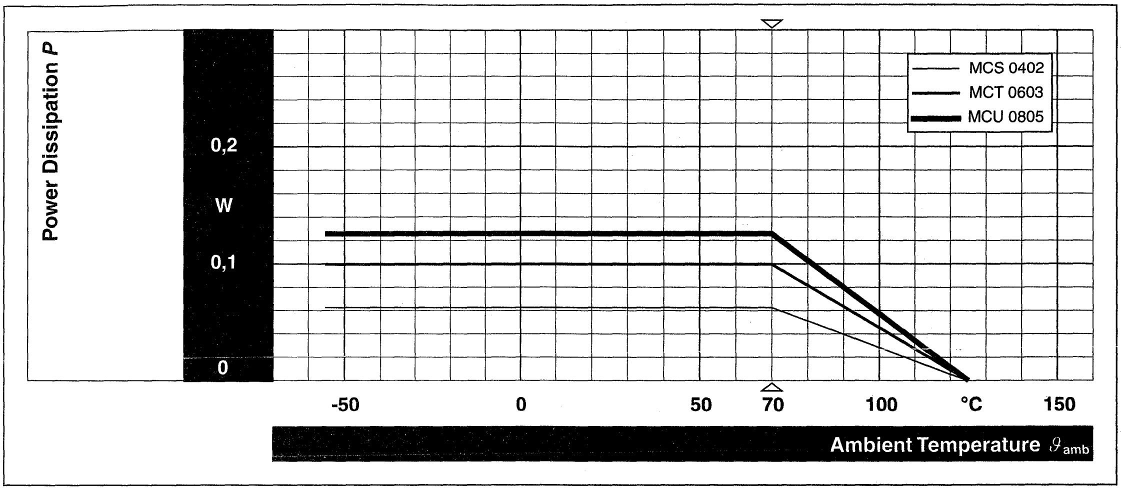


Fig.1 Derating, standard operation.

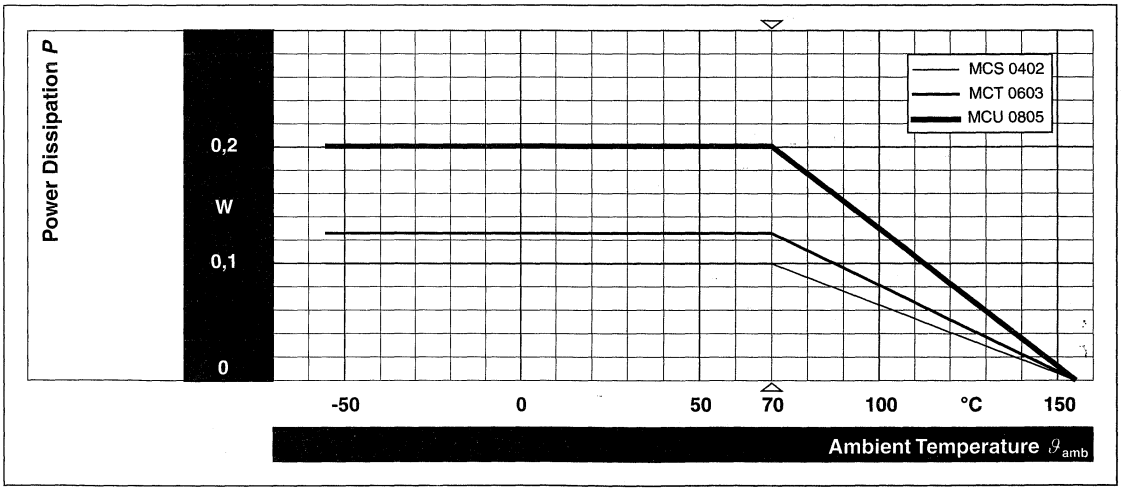


Fig.2 Derating, power operation.

Single pulse

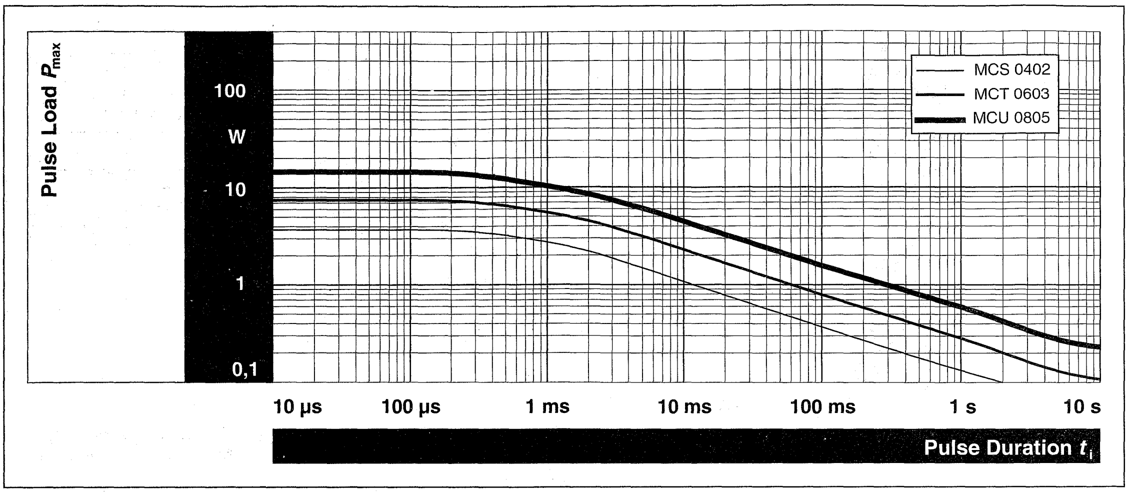


Fig.3 Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation.

Continuous pulse

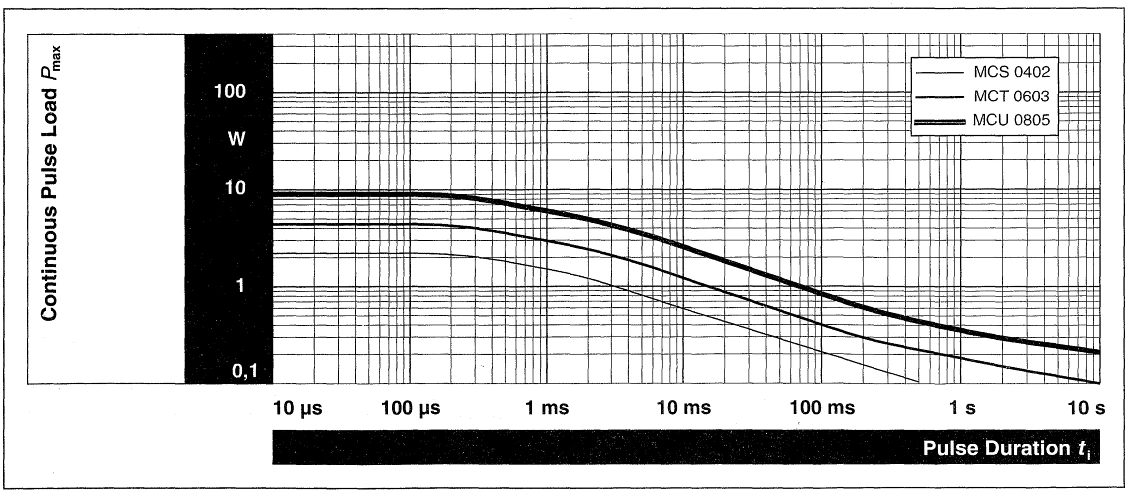


Fig.4 Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Pulse voltage

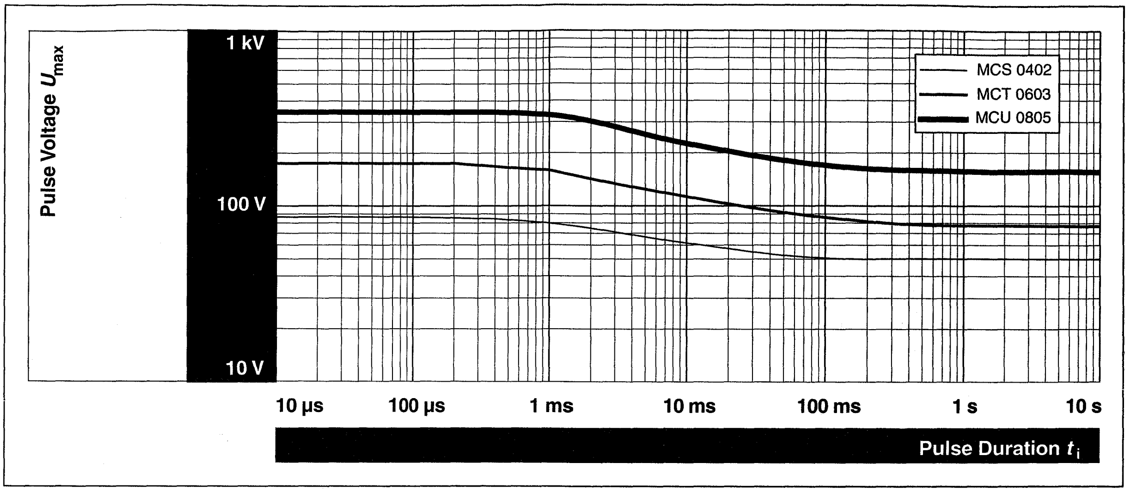


Fig.5 Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Professional flat chip resistors MCS 0402; MCT 0603; MCU 0805

1,2/50 pulse

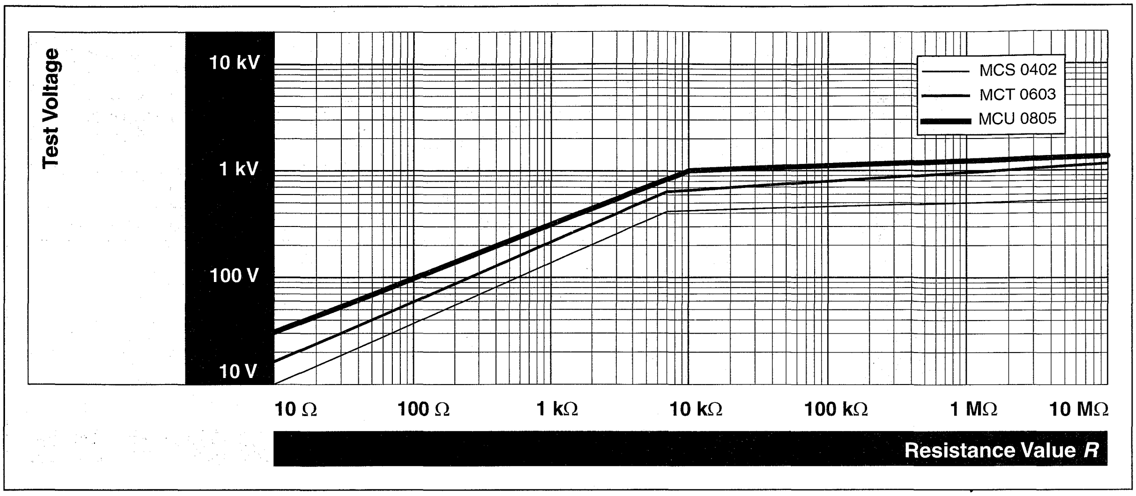


Fig.6 Pulse load rating in accordance with IEC 60115-1 clause 4.27; 1,2 µs / 50 µs; 5 pulses at 12 s interval; for permissible resistance change 0,5%.

10/700 pulse

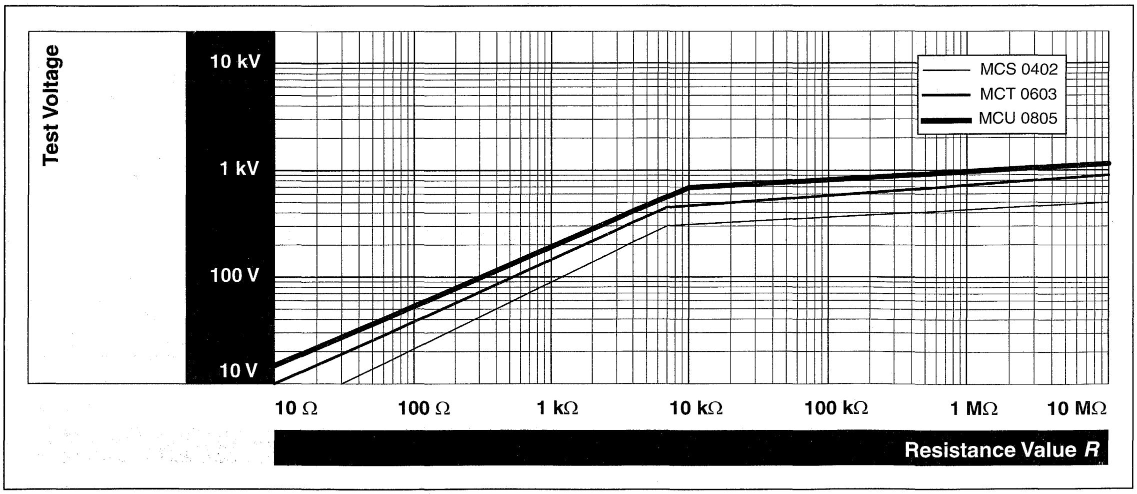


Fig.7 Pulse load rating in accordance with IEC 60115-1 clause 4.27; 10 µs / 700 µs; 10 pulses at 1 minute intervals; for permissible resistance change 0,5%.

Current noise

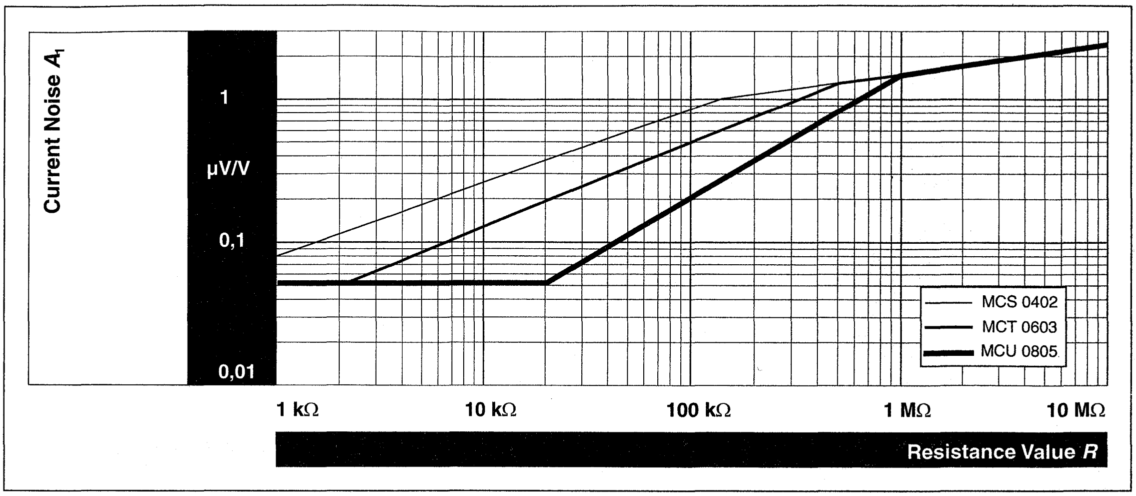


Fig.8 Current noise A_1 in accordance with IEC 60195.

RF-behaviour

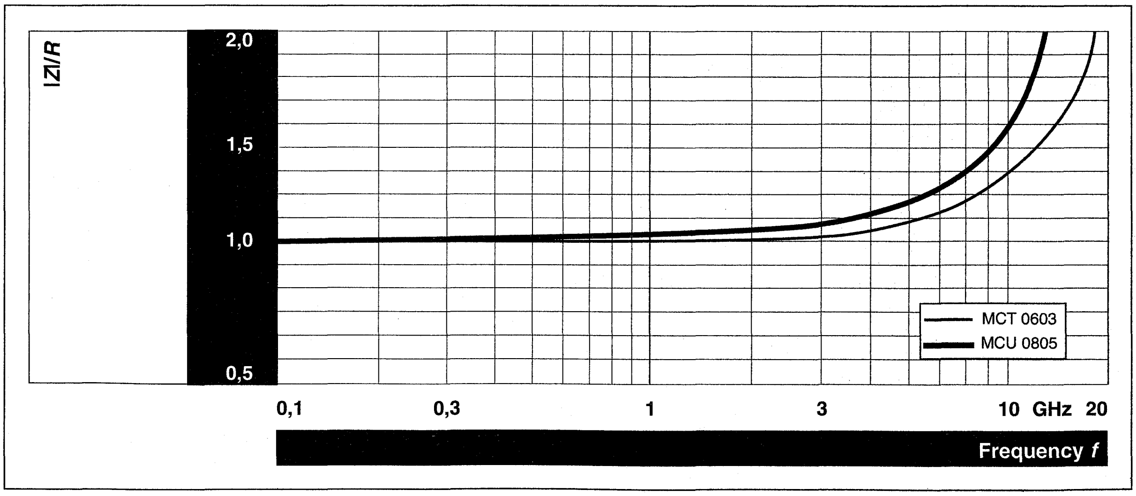
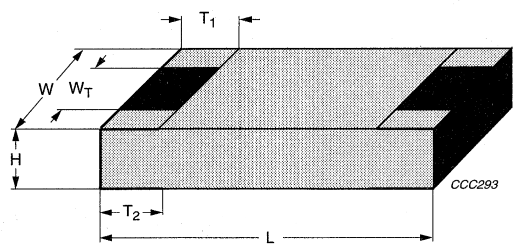


Fig.9 $|Z|/R$ for 49,9 Ω chip resistor.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.10 Outlines.

Table 4 Chip resistor types, mass and relevant physical dimensions; see Fig.10

TYPE	H (mm)	L (mm)	W (mm)	W_T (mm)	T_1 (mm)	T_2 (mm)	MASS (mg)
MCS 0402	0,32 ± 0,05	1,0 ±0,05	0,5 ±0,05	> 75% of W	0,2 +0,1/–0,15	0,2 ±0,1	0,8
MCT 0603	0,45 +0,1/–0.05	1,55 ±0,05	0,85 ±0,1	> 75% of W	0,3 +0,15/–0,2	0,3 +0,15/–0.2	1,5
MCU 0805	0,45 +0,1/–0.05	2,0 ±0,1	1,25 ±0,15	> 75% of W	0,4 +0,1/–0,2	0,4 +0,1/–0,2	3,2

Professional flat chip resistors MCS 0402; MCT 0603; MCU 0805

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 140 400 / IEC 60115-1, Sectional Specification (includes Schedule for Qualification approval)

CECC 40 401-801, Detail Specification (includes Schedule for Conformance inspection)

Most of the components are approved in accordance with the European CECC-system, where applicable. The table below contains only the most important tests. For the full test schedule refer to the documents mentioned 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$) STABILITY CLASS 0,5	STABILITY CLASS 1
			stability for product types:		
			MCS 0402	10 Ω to 33,2 kΩ	> 33,2 kΩ to 4,99 MΩ
			MCT 0603	10 Ω to 100 kΩ	1 Ω to <10 Ω; >100 kΩ to 10 MΩ
			MCU 0805	10 Ω to 221 kΩ	1 Ω to <10 Ω; >221 kΩ to 10 MΩ
4.5	–	resistance		±1%; ±0,5%	
4.8.4.2	–	temperature coefficient	at 20 / LCT / 20 °C and 20 / UCT / 20 °C	±50 ppm/K; ±25 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; 1000 h	±(0,25% + 0,05 Ω)	±(0,5% + 0,05 Ω)
			70 °C; 8000 h	±(0,5% + 0,05 Ω)	±(1% + 0,05 Ω)
4.25.3	–	endurance at upper category temperature	125 °C; 1000 h	±(0,5% + 0,05 Ω)	±(1% + 0,05 Ω)
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±(0,5% + 0,05 Ω)	±(1% + 0,05 Ω)

Professional flat chip resistors MCS 0402; MCT 0603; MCU 0805

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)	
				STABILITY CLASS 0,5	STABILITY CLASS 1
			stability for product types:		
			MCS 0402	10 Ω to 33,2 kΩ	> 33,2 kΩ to 4,99 MΩ
			MCT 0603	10 Ω to 100 kΩ	1 Ω to <10 Ω; >100 kΩ to 10 MΩ
			MCU 0805	10 Ω to 221 kΩ	1 Ω to <10 Ω; >221 kΩ to 10 MΩ
4.23		climatic sequence:			
4.23.2	2 (Ba)	dry heat	125 °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 to 35 °C		
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	±(0,5% + 0,05 Ω) no visible damage	±(1% + 0,05 Ω) no visible damage
–	1 (Aa)	cold	−55 °C; 2 h	±(0,1% + 0,01 Ω)	±(0,25% + 0,05 Ω)
4.13		short time overload	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±(0,1% + 0,01 Ω) no visible damage	±(0,25% + 0,05 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±(0,1% + 0,01 Ω) no visible damage	±(0,25% + 0,05 Ω) no visible damage
4.29	45 (XA)	component solvent resistance	isopropyl alcohol +23 °C; tooth brush method	marking legible; no visible damage	
4.18.2	20 (Tb)	resistance to soldering heat	unmounted components; 260 ±5 °C; 10 ±1 s	±(0,1% + 0,01 Ω) no visible damage	±(0,25% + 0,05 Ω) no visible damage
4.17.2	20 (Ta)	solderability	+215 °C; 3 s solder bath method	good tinning (≥95% covered); no visible damage	
4.32	21 (Ul_3)	shear (adhesion)	5 N; 10 s	no visible damage	
4.7		voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown	

Precision flat chip resistors MCT 0603; MCU 0805; MCA 1206

FEATURES

- Thin-film technology
- Low TC: ±10 to ±25 ppm/K
- Precision tolerance of value: 0,1 and 0,25%
- Superior overall stability: class 0,1 and 0,25
- Case sizes:
  - Imperial: 0603; 0805; 1206
  - Metric: RR 1608M; RR 2012M; RR 3216M.

APPLICATIONS

- Test and measuring equipment
- Medical equipment
- Industrial equipment.

DESCRIPTION

MCT 0603, MCT 0805 and MCA 1206 Precision Thin Film Flat Chip 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 together with industrial and medical electronics.

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal alloy is deposited on a super high grade (96% Al_2O_3) ceramic substrate and conditioned to achieve the desired temperature coefficient. Specially designed inner contacts are deposited on both sides. A special laser is used to achieve the target value by smoothly fine trimming the resistive layer without damaging the ceramics. A further conditioning is applied in order to stabilize the trimming result. The resistor elements are covered by a blue protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100% of the individual chip resistors. Only accepted products are laid directly into the paper tape in accordance with **IEC 60286-3**.

The resistors are suitable for processing on automatic SMD assembly systems and for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with **CECC 40401-801** which refers to **EN 140000 (IEC 60115-1)** and **EN 140400 (IEC 60115-8)**.

BCcomponents BEYSCHLAG has achieved **"Approval of Manufacturer"** in accordance with **EN 100114-1**. The release certificate for **"Technology Approval Schedule"** in accordance with **CECC 240001** based on **EN 100114-6** is granted for the BCcomponents BEYSCHLAG manufacturing process.

On request, resistors are available with established reliability in accordance with **CECC 40401-803 Version E**.

Precision flat chip resistors MCT 0603; MCU 0805; MCA 1206

QUICK REFERENCE DATA

DESCRIPTION	MCT 0603		MCU 0805		MCA 1206
Metric size	RR 1608M		RR 2012M		RR 3216M
Resistance range	47 Ω to 150 kΩ		47 Ω to 221 kΩ		47 Ω to 332 kΩ
Resistance tolerance	±0,25%; ±0,1%				±0,1%
Temperature coefficient	±25 ppm/K; ±15 ppm/K; ±10 ppm/K				±25 ppm/K
Operation mode	precision	standard	precision	standard	standard
Climatic category (LCT/UCT/days)	10/85/56	55/125/56	10/85/56	55/125/56	55/125/56
Rated dissipation, P_{70}	0,032 W	0,1 W	0,050 W	0,125 W	0,125 W
Operating voltage, U_{max} AC/DC	25 V	75 V	35 V	150 V	150 V
Film temperature	85 °C	125 °C	85 °C	125 °C	125 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	100 Ω to 18 kΩ		100 Ω to 33 kΩ		47 Ω to 332 kΩ
1 000 h	≤ 0,1%	≤ 0,25%	≤ 0,1%	≤ 0,25%	≤ 0,1%
8 000 h	≤ 0,25%	≤ 0,5%	≤ 0,25%	≤ 0,5%	≤ 0,25%
225 000 h	≤ 0,5%	≤ 1,0%	≤ 0,5%	≤ 1,0%	≤ 0,5%
Specified lifetime	225 000 h		225 000 h		225 000 h
Permissible voltage against ambient:					
1 minute	100 V		200 V		200 V
continuous	75 V		75 V		75 V
Failure rate	$\leq 2 \times 10^{-9}$/h		$\leq 2 \times 10^{-9}$/h		$\leq 2 \times 10^{-9}$/h

Precision flat chip resistors MCT 0603; MCU 0805; MCA 1206

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[1]		
T.C.	**TOLERANCE**	**MCT 0603**	**MCU 0805**	**MCA 1206**
±25 ppm/K	±0,25%	**47 Ω to 150 kΩ**	**47 Ω to 221 kΩ**	–
	±0,1%	**100 Ω to 150 kΩ**	**47 Ω to 221 kΩ**	**47 Ω to 332 kΩ**
±15 ppm/K	±0,25%	47 Ω to 150 kΩ	47 Ω to 100 kΩ	–
	±0,1%	**100 Ω to 100 kΩ**	**100 Ω to 100 kΩ**	–
±10 ppm/K()	±0,25%	47 Ω to 20 kΩ	47 Ω to 36 kΩ	–
	±0,1%	**100 Ω to 20 kΩ**	**100 Ω to 36 kΩ**	–

Notes

1. Resistance values to be selected from E96 and E192 series, other values are available on request.

TC 10 is specified over the temperature range from −10 °C to 85 °C.

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

ORDERING INFORMATION

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

Numeric ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312 ... . CARDBOARD TAPE ON REEL		
TYPE	T.C.	TOL.	P1 1000 units	P5 5000 units	PW 20000 units
MCT 0603	±25 ppm/K	±0,25%	201 6....	**216 6....**	206 6....
		±0,1%	201 7....	**216 7....**	206 7....
	±15 ppm/K	±0,25%	202 6....	217 6....	207 6....
		±0,1%	202 7....	**217 7....**	207 7....
	±10 ppm/K	±0,25%	203 6....	218 6....	208 6....
		±0,1%	203 7....	**218 7....**	208 7....
MCU 0805	±25 ppm/K	±0,25%	241 6....	**256 6....**	246 6....
		±0,1%	241 7....	**256 7....**	246 7....
	±15 ppm/K	±0,25%	242 6....	257 6....	247 6....
		±0,1%	242 7....	**257 7....**	247 7....
	±10 ppm/K	±0,25%	243 6....	258 6....	248 6....
		±0,1%	243 7....	**258 7....**	248 7....
MCA 1206	±25 ppm/K	±0,1%	381 7....	**396 7....**	386 7....

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

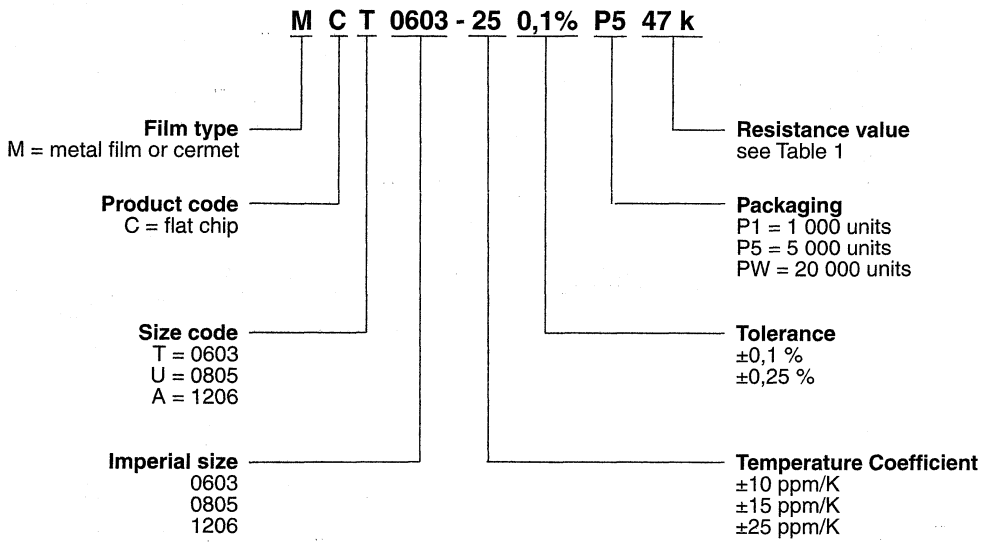
RESISTANCE DECADE	LAST DIGIT
10 to 99,9 Ω	9
100 to 999 Ω	1
1 to 9,99 kΩ	2
10 to 99,9 kΩ	3
100 to 999 kΩ	4

ORDERING EXAMPLE

The ordering code of a MCT 0603 resistor, value 47 kΩ and TC 25 with ±0,1% tolerance, supplied in cardboard tape of 5 000 units per reel is: 2312 216 74703.

Type description and ordering code

- We recommend that the clear text ordering code is used, to minimize the possibility of errors in order handling.



FUNCTIONAL DESCRIPTION

Derating

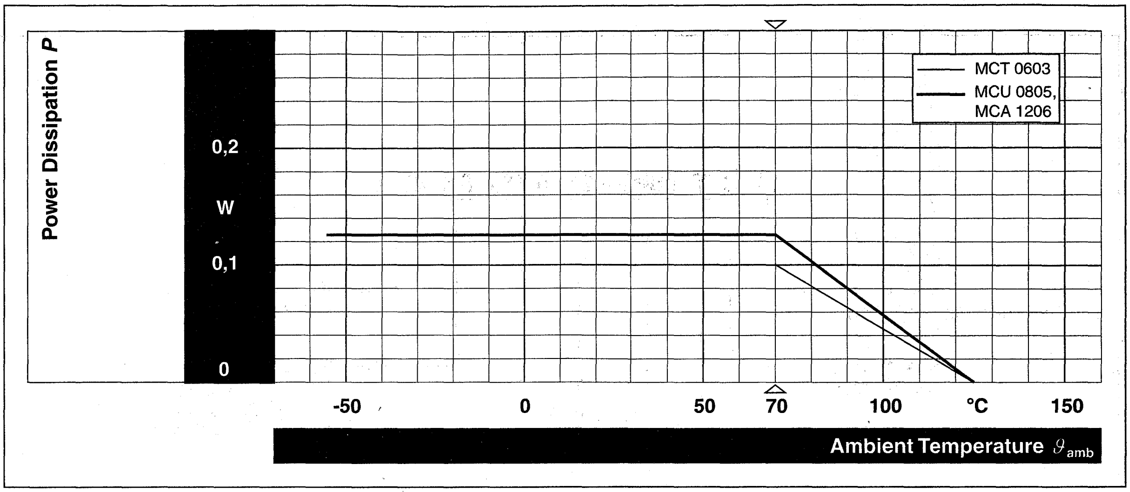


Fig.1 Derating, standard operation.

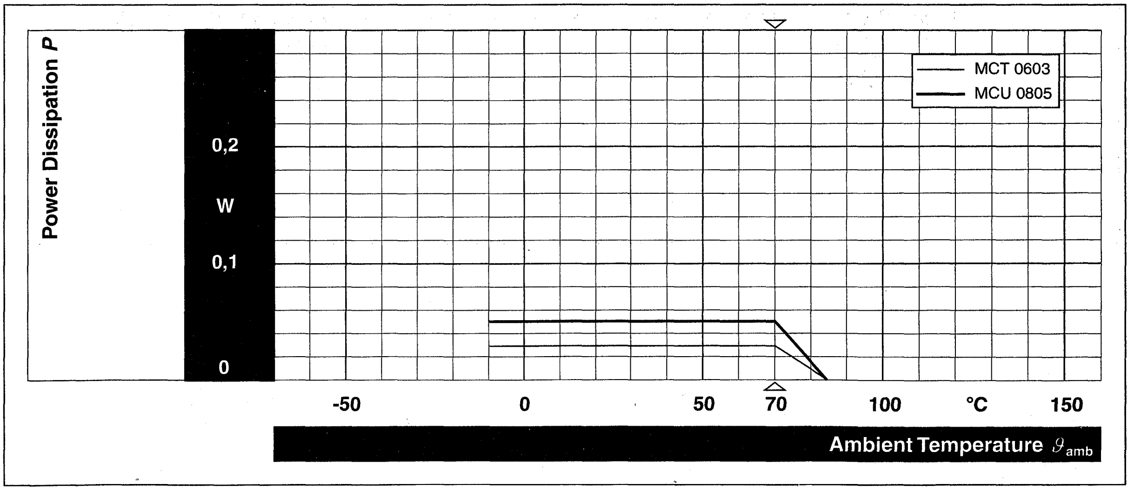


Fig.2 Derating, precision operation.

Current noise

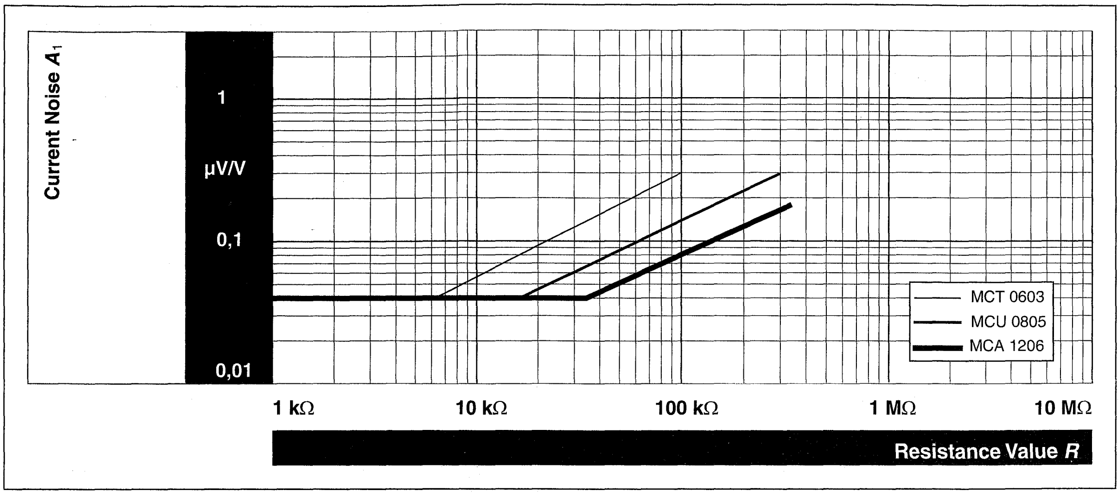
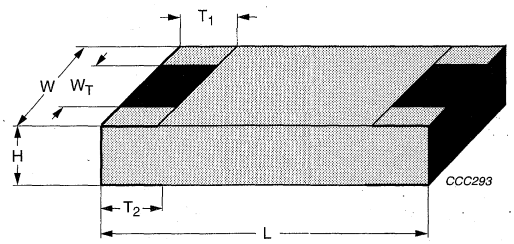


Fig.3 Current noise A_1 in accordance with IEC 60195.

Precision flat chip resistors MCT 0603; MCU 0805; MCA 1206

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.4 Outlines.

Table 4 Chip resistor types, mass and relevant physical dimensions; see Fig.4

TYPE	H (mm)	L (mm)	W (mm)	W_T (mm)	T_1 (mm)	T_2 (mm)	MASS (mg)
MCT 0603	0,45 +0,1/–0,05	1,55 ±0,05	0,85 ±0,1	> 75% of W	0,3 +0,15/–0,2	0,3 +0,15/–0,2	1,5
MCU 0805	0,45 +0,1/–0,05	2,0 ±0,1	1,25 ±0,15	> 75% of W	0,4 +0,1/–0,2	0,4 +0,1/–0,2	3,2
MCA 1206	0,55 ±0,1	3,2 +0,1/–0,2	1,6 ±0,15	> 75% of W	0,5 ±0,25	0,5 ±0,25	10,0

Precision flat chip resistors MCT 0603; MCU 0805; MCA 1206

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 140400 / IEC 60115-1, Sectional specification (includes schedule for qualification approval)

CECC 40401-801, Detail specification (includes schedule for conformance inspection)

Most of the components are approved in accordance with the European CECC-system, where applicable. Table 5 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)		
				–	STABILITY CLASS 0,1	STABILITY CLASS 0,25
			stability for product types:			
			MCT 0603	–	100 Ω to 18 kΩ	> 18 kΩ
			MCU 0805	–	100 Ω to 33 kΩ	> 33 kΩ
			MCA 1206	47 Ω to 332 kΩ	–	–
4.5	–	resistance		±0,1%	±0,1%; ±0,25%	
4.8.4.2	–	temperature coefficient	at 20 / LCT / 20 °C and 20 / UCT / 20 °C	±25 ppm/K	±25 ppm/K; ±15 ppm/K; ±10 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; 1000 h	±0,1%	±(0,1% + 0,02 Ω)	±0,25%
			70 °C; 8000 h	±0,25%	±(0,25% + 0,05 Ω)	±0,5%
4.25.3	–	endurance at upper category temperature	125 °C; 1000 h	±0,25%	–	±0,25%
			85 °C; 1000 h	–	±(0,1% + 0,02 Ω)	–
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±0,25%	±(0,1% + 0,02 Ω)	±0,25%

Precision flat chip resistors MCT 0603; MCU 0805; MCA 1206

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (Δ*R*/*R*)		
				–	STABILITY CLASS 0,1	STABILITY CLASS 0,25
			stability for product types:			
			MCT 0603	–	100 Ω to 18 kΩ	> 18 kΩ
			MCU 0805	–	100 Ω to 33 kΩ	> 33 kΩ
			MCA 1206	47 Ω to 332 kΩ	–	–
4.23		climatic sequence:				
4.23.2	2 (Ba)	dry heat	125 °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 to 35 °C			
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	±0,25% no visible damage	±(0,1% + 0,02 Ω) no visible damage	±0,25% no visible damage
–	1 (Aa)	cold	–55 °C; 2 h	–	±(0,05% + 0,01 Ω)	±0,05%
4.13	–	short time overload	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±0,1% no visible damage	±(0,05% + 0,01 Ω) no visible damage	±0,05% no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±0,1% no visible damage	±(0,05% + 0,01 Ω) no visible damage	±0,05% 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 ±5 °C; 10 ±1 s	±0,1% no visible damage	±(0,05% + 0,01 Ω) no visible damage	±0,05% no visible damage
4.17.2	20 (Ta)	solderability	+215 °C; 3 s solder bath method	good tinning (≥95% covered); no visible damage		
4.32	21 (Ul_3)	shear (adhesion)	5 N; 10 s	no visible damage		
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown		

High ohmic flat chip resistors OCT 0603; OCU 0805

FEATURES

- Unique very high ohmic chip resistor product
- Standard TC: ±100 ppm/K
- Excellent overall stability
- Low voltage coefficient: 0,05%/V
- Wide high ohmic range: > 10 MΩ to 130 MΩ
- Sizes:
  - Imperial: 0603; 0805
  - Metric: RR 1608M; RR 2012M

APPLICATIONS

- Any kind of battery driven electronics
- Low consumption CMOS circuitry
- Small signal measurement.

DESCRIPTION

OCT 0603 and OCU 0805 high ohmic flat chip resistors are best suited where high resistance, high stability and high reliability are required. Typical applications include any kind of battery driven electronics, particularly low consumption CMOS circuitry.

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A newly developed Cermet layer is deposited on a super high grade (Al_2O_3) ceramic substrate and conditioned to achieve the desired temperature coefficient. Inner contacts are built on both sides of the substrate. A special laser is used to achieve the target value by smoothly cutting the resistive layer without damaging the ceramics. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100% of the individual chip resistors. Only accepted products are laid directly into the paper tape in accordance with **IEC 60286-3**.

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with **CECC 40401-802** which refers to **EN 140 000** (**IEC 60 115-1**) and **EN 140400** (**IEC 60115-8**).

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

QUICK REFERENCE DATA

DESCRIPTION	OCT 0603		OCU 0805	
Metric size	RR 1608M		RR 2012M	
Resistance range	11 MΩ to 130 MΩ		11 MΩ to 130 MΩ	
Resistance tolerance	±5%			
Temperature coefficient	±250 ppm/K; ±100 ppm/K			
Operation mode	standard	power	standard	power
Climatic category (LCT/UCT/days)	55/125/56	55/155/56	55/125/56	55/155/56
Rated dissipation, P_{70}	limited by U_{max}			
Operating voltage, U_{max} AC/DC	75 V	150 V	150 V	200 V
Film temperature	125 °C	155 °C	125 °C	155 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	11 MΩ to 47 MΩ		11 MΩ to 47 MΩ	
1000 h	≤ 1%	≤ 2%	≤ 1%	≤ 2%
8000 h	≤ 2%	≤ 4%	≤ 2%	≤ 4%
Specified lifetime	8000 h			
Permissible voltage against ambient:				
1 minute	100 V		200 V	
continuous	75 V		75 V	
Failure rate	$\leq 2 \times 10^{-9}$/h		$\leq 2 \times 10^{-9}$/h	

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[(1)]	
T.C.	**TOLERANCE**	**OCT 0603**	**OCU 0805**
±250 ppm/K	±5%	51 MΩ to 130 MΩ	51 MΩ to 130 MΩ
±100 ppm/K	±5%	**11 MΩ to 47 MΩ**	**11 MΩ to 47 MΩ**

Note

1. Resistance values to be selected from E24 series.

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION				ORDERING CODE 2312	
				CARDBOARD TAPE ON REEL	
TYPE	T.C.	TOL.	RESISTANCE VALUE	P5 5000 units	PW 20000 units
OCT 0603	±250 ppm/K	±5%	51 MΩ to 91 MΩ	219 3....	209 3....
			≥ 100 MΩ(1)	219 901..	209 901..
	±100 ppm/K	±5%	11 MΩ to 47 MΩ	**219 3....**	209 3....
OCU 0805	±250 ppm/K	±5%	51 MΩ to 91 MΩ	259 3....	249 3....
			≥ 100 MΩ(1)	259 901..	249 901..
	±100 ppm/K	±5%	11 MΩ to 47 MΩ	**259 3....**	249 3....

Note

1. Readable coding of resistance values is restricted to values below 100 MΩ. For resistance values from 100 MΩ onwards, refer to the pre-defined Table 4 of non-readable sequential numbers.

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

RESISTANCE DECADE	LAST DIGIT
10 MΩ to 99,9 MΩ	6

Table 4 Last two digits indicating sequential code number

RESISTANCE VALUE	LAST DIGITS
100 MΩ	01
110 MΩ	02
120 MΩ	03
130 MΩ	04

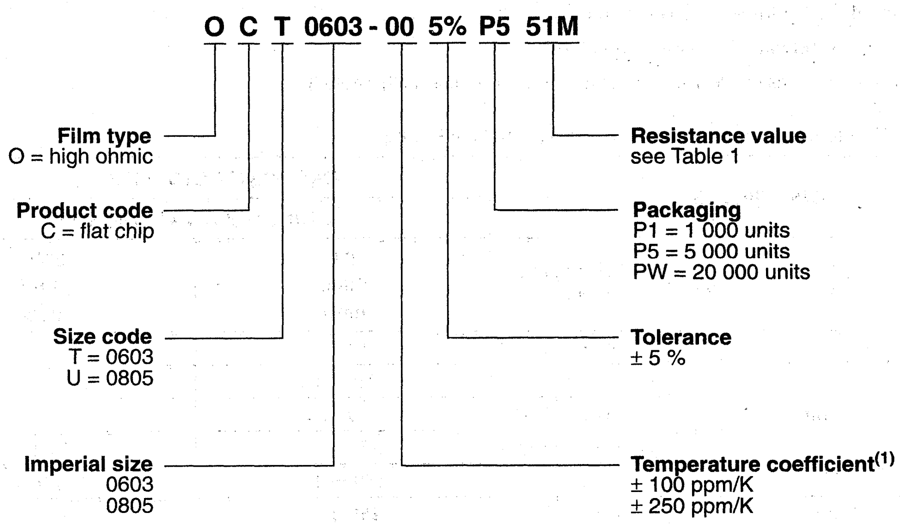
ORDERING EXAMPLES

The ordering code of a OCT 0603 resistor, value 51 MΩ and TC 250 with ±5% tolerance, supplied in cardboard tape of 20000 units per reel is: 2312 209 35106.

The ordering code of a OCT 0603 resistor, value 130 MΩ and TC 250 with ±5% tolerance, supplied in cardboard tape of 5000 units per reel is: 2312 219 90104.

Type description and ordering code

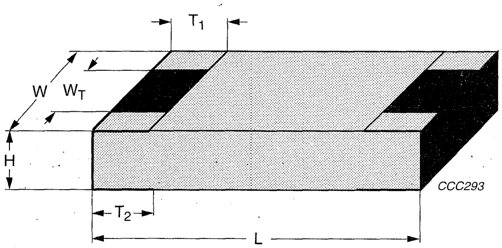
- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



(1) A temperature coefficient ±100 ppm/K is marked -00, higher T.C. values are not identified.

MECHANICAL DATA

Outlines



For dimensions see Table 5.

Fig.1 Outlines.

Table 5 Chip resistor types, mass and relevant physical dimensions; see Fig.1

TYPE	H (mm)	L (mm)	W (mm)	W_T (mm)	T_1 (mm)	T_2 (mm)	MASS (mg)
OCT 0603	0,45 +0,1/−0,05	1,55 ±0,05	0,85 ±0,1	> 75% of W	0,3 +0,15/−0,2	0,3 +0,15/−0,2	1,5
OCU 0805	0,45 +0,1/−0,05	2,0 ±0,1	1,25 ±0,15	> 75% of W	0,4 +0,1/−0,2	0,4 +0,1/−0,2	3,2

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 140400 / IEC 60115-8, Sectional specification (includes schedule for qualification approval)

CECC 40401-802, Detail specification (includes schedule for conformance inspection)

Most of the components are approved in accordance with the European CECC-system, where applicable. Table 6 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 1 060 mbar).

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

In Table 6 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.

Table 6 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types:	
			OCT 0603	11 MΩ to 130 MΩ
			OCU 0805	11 MΩ to 130 MΩ
4.5	–	resistance	U = 100 V	±5%
4.8.4.2	–	temperature coefficient	at 20 / LCT / 20 °C and 20 / UCT / 20 °C	±250 ppm/K; ±100 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; 1 000 h	±1%
			70 °C; 8000 h	±2%
4.25.3	–	endurance at upper category temperature	125 °C; 1 000 h	±2%
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±2%

High ohmic flat chip resistors OCT 0603; OCU 0805

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types:	
			OCT 0603	11 MΩ to 130 MΩ
			OCU 0805	11 MΩ to 130 MΩ
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	125 °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 to 35 °C	
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	±2% no visible damage
–	1 (Aa)	cold	−55 °C; 2 h	±0,5 %
4.13	–	short time overload	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±0,5% no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±0,5% 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 ±5 °C; 10 ±1 s	±0,5% no visible damage
4.17.2	20 (Ta)	solderability	+215 °C; 3 s solder bath method	good tinning (≥95% covered); no visible damage
4.32	21 (Ue_3)	shear (adhesion)	5 N; 10 s	no visible damage
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown

Low ohmic flat chip resistors — NCT 0603; NCU 0805

FEATURES

- Unique low ohmic chip resistor
- Standard TC: ±100 ppm/K
- Excellent overall stability
- Wide low ohmic range: 0,22 Ω to < 1 Ω
- Sizes:
  - Imperial: 0603; 0805
  - Metric: RR 1608M; RR 2012M

APPLICATIONS

- Power supplies
- Battery chargers
- Computer industry.

DESCRIPTION

NCT 0603 and NCU 0805 low ohmic flat chip resistors are best suited where low resistance paired with high stability and high reliability is required. Typical applications include current sensors and shunts in power supplies and battery chargers. Other demands for low ohmic resistors come from the computer industry.

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A highly conductive film is built on a super high grade (96% Al_2O_3) ceramic substrate and conditioned to achieve the desired temperature coefficient. Optimised inner contacts are built on both sides of the substrate. A special laser is used to achieve the target value by smoothly cutting the resistive layer without damaging the ceramics. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100% of the individual chip resistors. Only accepted products are laid directly into the paper tape in accordance with **IEC 60 286-3.**

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with **CECC 40 401-802** which refers to **EN 140 000 (IEC 60115-1)** and **EN 140 400 (IEC 60115-8)**.

BCcomponents BEYSCHLAG has achieved **"Approval of Manufacturer"** in accordance with **EN 100 114-1**.

Low ohmic flat chip resistors — NCT 0603; NCU 0805

QUICK REFERENCE DATA

DESCRIPTION	NCT 0603		NCU 0805	
Metric size	RR 1608M		RR 2012M	
Resistance range	0,22 Ω to 0,91 Ω		0,22 Ω to 0,91 Ω	
Resistance tolerance	±5%			
Temperature coefficient	±100 ppm/K			
Operation mode	standard	power	standard	power
Climatic category (LCT/UCT/days)	55/125/56	55/155/56	55/125/56	55/155/56
Rated dissipation, P_{70}	0,1 W	0,125 W	0,125 W	0,2 W
Operating voltage, U_{max} AC/DC	limited by P_{70}			
Film temperature	125 °C	155 °C	125 °C	155 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	0,22 Ω to 0,91 Ω		0,22 Ω to 0,91 Ω	
1 000 h	≤ 2%	≤ 4%	≤ 2%	≤ 4%
8 000 h	≤ 4%	–	≤ 4%	–
Specified lifetime	8 000 h		8 000 h	
Permissible voltage against ambient:				
1 minute	100 V		200 V	
continuous	75 V		75 V	
Failure rate	$\leq 2 \times 10^{-9}$/h		$\leq 2 \times 10^{-9}$/h	

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[1]	
T.C.	TOLERANCE	NCT 0603	NCU 0805
±100 ppm/K	±5%	**0,22 Ω to 0,91 Ω**	**0,22 Ω to 0,91 Ω**

Note

1. Resistance values to be selected from E24 series.

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312	
			CARDBOARD TAPE ON REEL	
TYPE	T.C.	TOL.	P5 5 000 units	PW 20000 units
NCT 0603	±100 ppm/K	±5%	**219 3....**	209 3....
NCU 0805			**259 3....**	249 3....

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

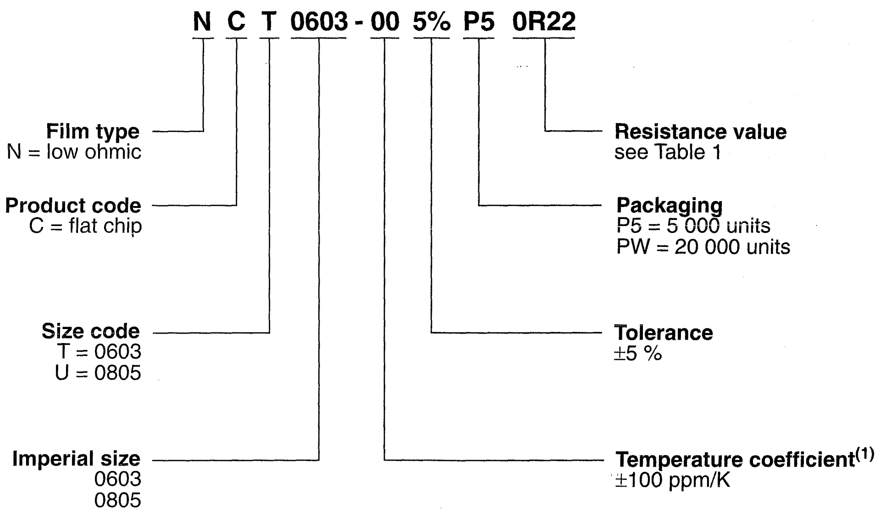
RESISTANCE DECADE	LAST DIGIT
0,1 to 0,99 Ω	7

ORDERING EXAMPLE

The ordering code of a NCT 0603 resistor, value 0,22 Ω and TC 100 with ±5% tolerance, supplied in cardboard tape of 5000 units per reel is: 2312 219 32207.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



(1) A temperature coefficient ±100 ppm/K is marked -00.

Low ohmic flat chip resistors NCT 0603; NCU 0805

FUNCTIONAL DESCRIPTION

Derating

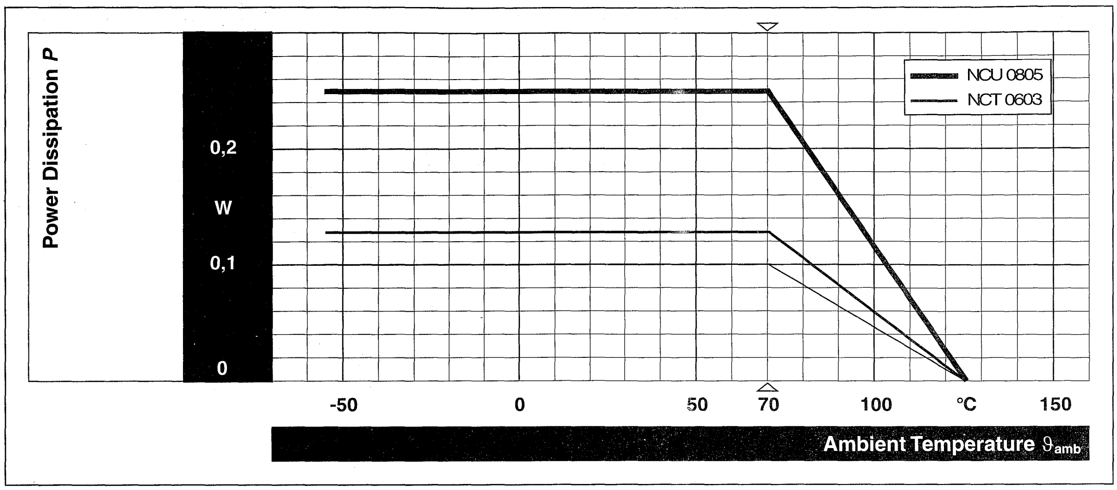


Fig.1 Derating, standard operation.

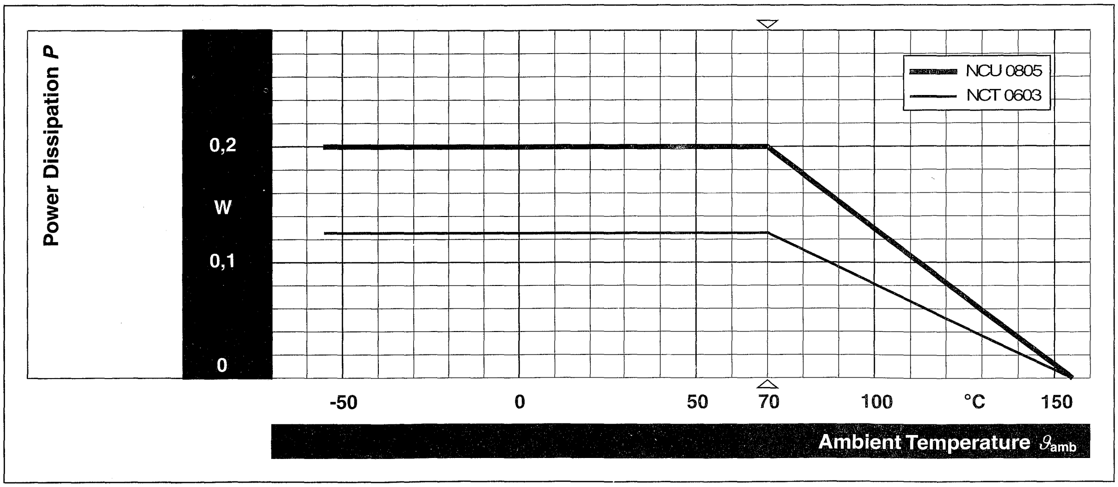
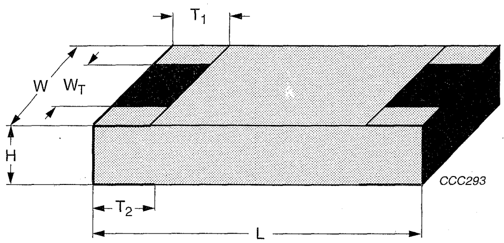


Fig.2 Derating, power operation.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.3 Outlines.

Table 4 Chip resistor types, mass and relevant physical dimensions; see Fig.3

TYPE	H (mm)	L (mm)	W (mm)	W_T (mm)	T_1 (mm)	T_2 (mm)	MASS (mg)
NCT 0603	0,45 +0,1/−0,05	1,55 ±0,05	0,85 ±0,1	> 75% of W	0,3 +0,15/−0,2	0,3 +0,15/−0,2	1,5
NCU 0805	0,45 +0,1/−0,05	2,0 ±0,1	1,25 ±0,15	> 75% of W	0,4 +0,1/−0,2	0,4 +0,1/−0,2	3,2

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 140 400 / IEC 60115-8, Sectional specification (includes schedule for qualification approval)

CECC 40 401-802, Detail specification (includes schedule for conformance inspection)

Most of the components are approved in accordance with the European CECC-system, where applicable. Table 5 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types:	
			NCT 0603	0,1 Ω to 0,91 Ω
			NCU 0805	0,1 Ω to 0,91 Ω
4.5	–	resistance		±5%
4.8.4.2	–	temperature coefficient	at 20 / LCT / 20 °C and 20 / UCT / 20 °C	±100 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; 1000 h	±(2% + 0,05 Ω)
			70 °C; 8000 h	±(4% + 0,05 Ω)
4.25.3	–	endurance at upper category temperature	125 °C; 1000 h	±(4% + 0,05 Ω)
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/−3% RH	±(2% + 0,05 Ω)

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types:	
			NCT 0603	0,1 Ω to 0,91 Ω
			NCU 0805	0,1 Ω to 0,91 Ω
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	125 °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 to 35 °C	
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	±(2% + 0,05 Ω) no visible damage
–	1 (Aa)	cold	−55 °C; 2 h	±(0,5% + 0,05 Ω)
4.13	–	short time overload	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±(0,5% + 0,05 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±(0,5% + 0,05 Ω) 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 ±5 °C; 10 ±1 s	±(0,5% + 0,05 Ω) no visible damage
4.17.2	20 (Ta)	solderability	+215 °C; 3 s solder bath method	good tinning (≥95% covered); no visible damage
4.32	21 (Ue_3)	shear (adhesion)	5 N; 10 s	no visible damage
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown

Trimmable flat chip resistors

TCT 0603; TCU 0805; TCA 1206

FEATURES

- Designed for state of the art laser trimming
- Enables economical functional circuit adjustment
- Low TC ±50 ppm/K available
- Excellent overall stability
- Wide ohmic range: 10 Ω to 1 MΩ
- Sizes:
  - Imperial: 0603; 0805; 1206
  - Metric: RR 1608M; RR 2012M; RR 3212M

APPLICATIONS

- Electronic sensors
- Oscillators
- Electronic circuits.

DESCRIPTION

TCT 0603, **TCU 0805** and **TCA 1206 trimmable flat chip resistors** are best suited whenever stable circuit adjustment is required and potentiometers will be either too expensive, too unstable or too large. The trimming is done directly on the printed-circuit board (PCB) using a state of the art laser trimming system e.g. with YAG or CO_2 laser source. Typical applications include any type of electronic sensors, oscillators or electronic circuits which have to be trimmed to certain functional parameters after PCB assembly.

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A newly developed cermet layer is deposited on a super high grade (96% Al_2O_3) ceramic substrate and conditioned to achieve the desired temperature coefficient. Pre contacts are built on both sides of the substrate. The resistor elements are covered by glass for superior electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure performed on 100% of the individual chip resistors. Only accepted products are laid directly into the paper tape in accordance with **IEC 60286-3**.

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with **CECC 40401-802** which refers to **EN 140000 (IEC 60115-1)** and **EN 140400 (IEC 60115-8)**.

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

Trimmable flat chip resistors

TCT 0603; TCU 0805; TCA 1206

QUICK REFERENCE DATA[1]

DESCRIPTION	TCT 0603		TCU 0805		TCA 1206
Metric size	RR 1608M		RR 2012M		RR 3212M
Resistance range	10 Ω to 1 MΩ		10 Ω to 1 MΩ		10 Ω to 1 MΩ
Resistance tolerance	+0/–30%; +0/–20%; +0/–10%				+0/-20%
Temperature coefficient	±100 ppm/K; ±50 ppm/K				±100 ppm/K
Operation mode	standard	power	standard	power	standard
Climatic category (LCT/UCT/days)	55/125/56	55/155/56	55/125/56	55/155/56	55/125/56
Rated dissipation, P_{70}	0,1 W	0,125 W	0,125 W	0,2 W	0,25 W
Operating voltage, U_{max} AC/DC	75 V		150 V		200 V
Film temperature	125 °C	155 °C	125 °C	155 °C	125 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	10 Ω to 1 MΩ		10 Ω to 1 MΩ		10 Ω to 1 MΩ
1 000 h	≤ 0,25%	≤ 0,5%	≤ 0,25%	≤ 0,5%	≤ 0,25%
8 000 h	≤ 0,5%	≤ 1,0%	≤ 0,5%	≤ 1,0%	≤ 0,5%
225 000 h	≤ 1,5%	–	≤ 1,5%	–	≤ 1,5%
Specified lifetime	225000 h	8000 h	225000 h	8000 h	225000 h
Permissible voltage against ambient:					
1 minute	100 V		200 V		200 V
continuous	75 V		75 V		75 V
Failure rate	$\leq 2 \times 10^{-9}$/h		$\leq 2 \times 10^{-9}$/h		$\leq 2 \times 10^{-9}$/h

Note

1. All given figures are valid for the untrimmed resistor.

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[1]		
T.C.	**TOLERANCE**	**TCT 0603**	**TCU 0805**	**TCA 1206**
±100 ppm/K	+0/−30%	10 Ω to 1 MΩ	10 Ω to 1 MΩ	−
	+0/−20%	**10 Ω to 1 MΩ**	**10 Ω to 1 MΩ**	10 Ω to 1 MΩ
	+0/−10%	10 Ω to 1 MΩ	10 Ω to 1 MΩ	−
±50 ppm/K	+0/−30%	100 Ω to 1 MΩ	100 Ω to 1 MΩ	−
	+0/−20%	**100 Ω to 1 MΩ**	**100 Ω to 1 MΩ**	−
	+0/−10%	100 Ω to 1 MΩ	100 Ω to 1 MΩ	−

Note

1. Resistance values to be selected from E12 (preferred) or E24 series.

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312 ... . CARDBOARD TAPE ON REEL	
TYPE	T.C.	TOL.	P5 5000 units	PW 20000 units
TCT 0603	±100 ppm/K	+0/–30%	300 1....	305 1....
		+0/–20%	**300 2....**	**305 2....**
		+0/–10%	300 3....	305 3....
	±50 ppm/K	+0/–30%	300 5....	305 5....
		+0/–20%	**300 6....**	**305 6....**
		+0/–10%	300 7....	305 7....
TCU 0805	±100 ppm/K	+0/–30%	320 1....	325 1....
		+0/–20%	**320 2....**	**325 2....**
		+0/–10%	320 3....	325 3....
	±50 ppm/K	+0/–30%	320 5....	325 5....
		+0/–20%	**320 6....**	**325 6....**
		+0/–10%	320 7....	325 7....
TCA 1206	±100 ppm/K	+0/–20%	340 2....	345 2....

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

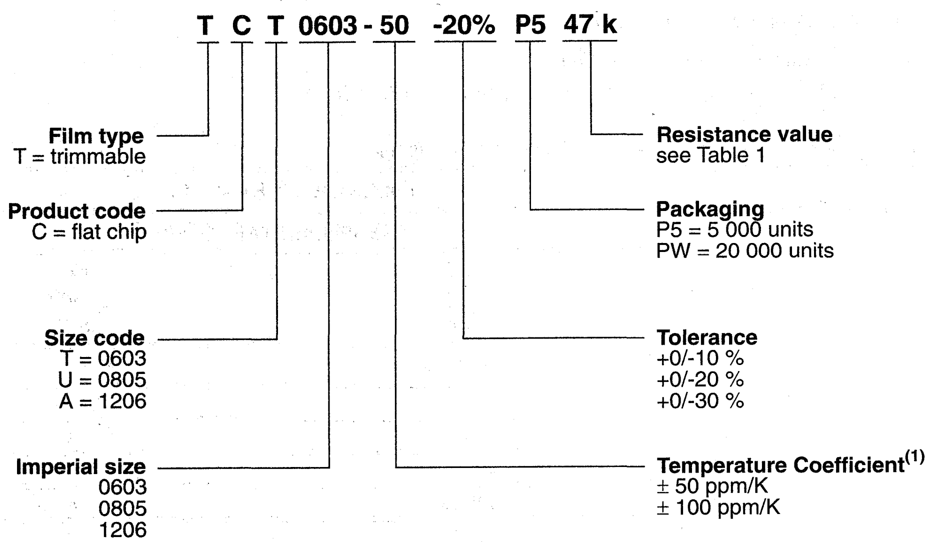
RESISTANCE DECADE	LAST DIGIT
10 Ω to 99,9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9,99 kΩ	2
10 kΩ to 99,9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9,99 MΩ	5

ORDERING EXAMPLE

The ordering code of a TCT 0603 resistor, value 47 kΩ and TC 50 with +0/–20% tolerance, supplied in cardboard tape of 5000 units per reel is: 2312 300 64703.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



(1) A temperature coefficient ±100 ppm/K is marked -00.

FUNCTIONAL DESCRIPTION

Derating

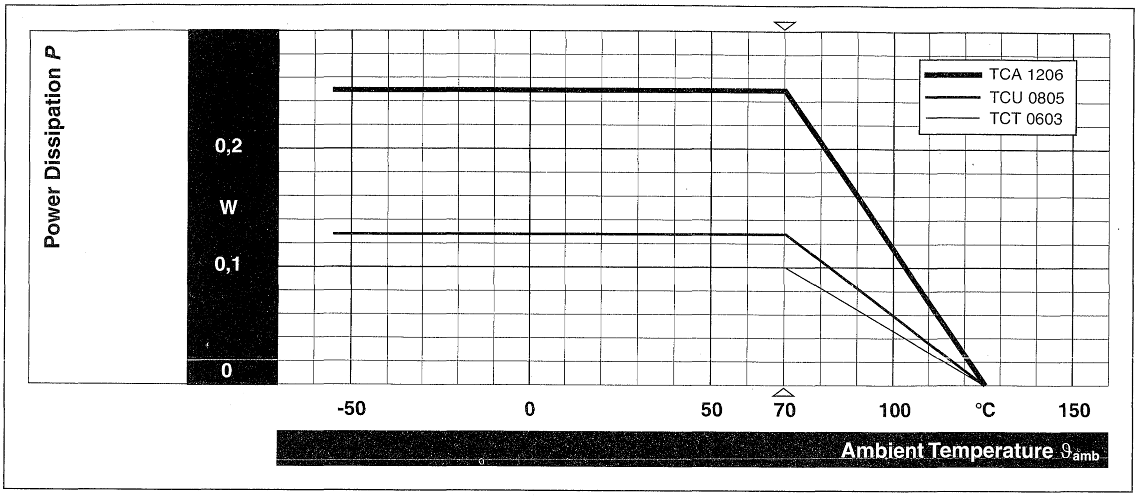


Fig.1 Derating, standard operation.

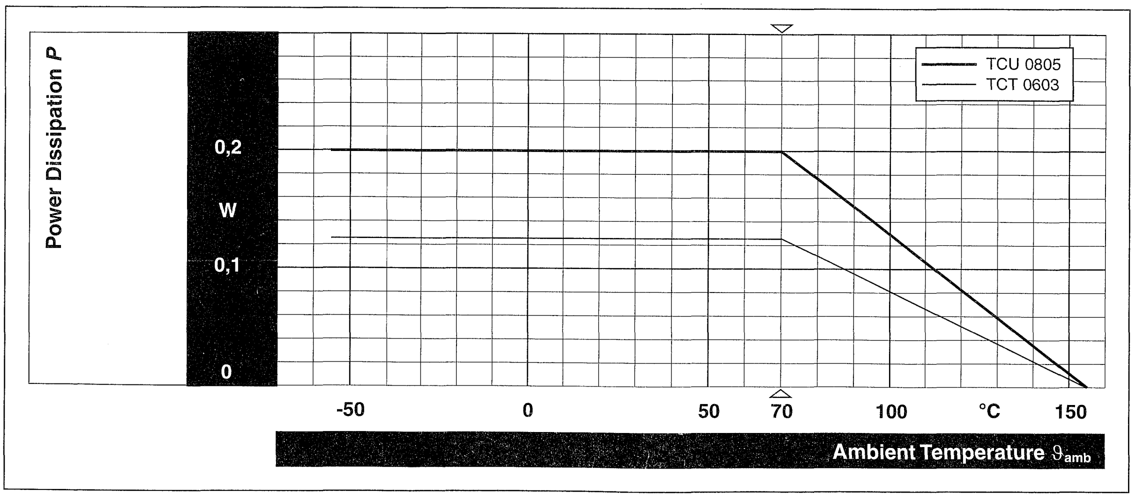
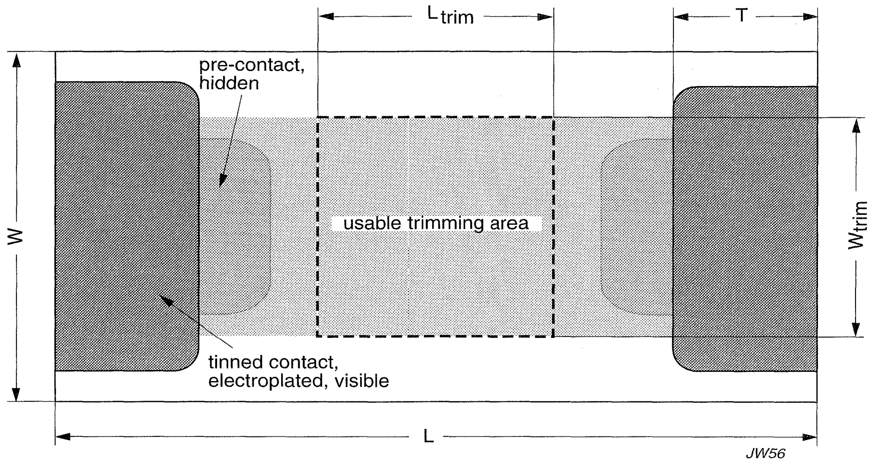


Fig.2 Derating, power operation.

Trimming area



For dimensions, see Table Fig.4.

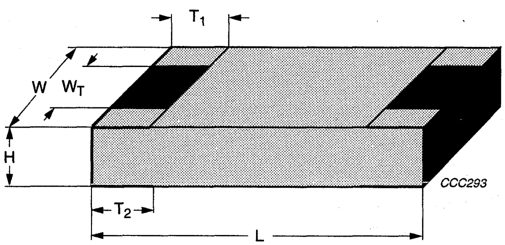
Fig.3 Permissible trimming area.

Table 4 Dimensions of the permissible trimming area; see Fig.3

TYPE	L (mm)	W (mm)	T (mm)	L_{trim} (mm)	W_{trim} (mm)
TCT 0603	1,6	0,8	0,3	0,5	0,5
TCU 0805	2,0	1,2	0,3	0,8	0,8
TCA 1206	3,2	1,6	0,4	1,4	1,0

MECHANICAL DATA

Outlines



For dimensions see Table 5.

Fig.4 Outlines.

Table 5 Chip resistor types, mass and relevant physical dimensions; see Fig.4

TYPE	H (mm)	L (mm)	W (mm)	W_T (mm)	T_1 (mm)	T_2 (mm)	MASS (mg)
TCT 0603	0,45 +0,1/–0,05	1,55 ±0,05	0,85 ±0,1	> 75% of W	0,3 +0,15/–0,2	0,3 +0,15/–0,2	1,5
TCU 0805	0,45 +0,1/–0,05	2,0 ±0,1	1,25 ±0,15	> 75% of W	0,4 +0,1/–0,2	0,4 +0,1/–0,2	3,2
TCA 1206	0,55 ±0,1	3,2 +0,1/–0,2	1,6 ±0,15	> 75% of W	0,5 ±0,25	0,5 ±0,25	10,0

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 140400 / IEC 60115-8, Sectional specification (includes schedule for qualification approval)

CECC 40401-802, Detail specification (includes schedule for conformance inspection)

Table 6 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 1 060 mbar).

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

In Table 6 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.

Table 6 Test procedures and requirements; see note 1

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types:	
			TCT 0603	10 Ω to 1 MΩ
			TCU 0805	10 Ω to 1 MΩ
			TCA 1206	10 Ω to 1 MΩ
4.5	–	resistance		+0/–30%; +0/–20%; +0/–10%
4.8.4.2	–	temperature coefficient	at 20 / LCT / 20 °C and 20 / UCT / 20 °C	±100 ppm/K; ±50 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; 1000 h	±0,25%
			70 °C; 8000 h	±0,5%
4.25.3	–	endurance at upper category temperature	125 °C; 1000 h	±0,25%
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±0,25%

Trimmable flat chip resistors

TCT 0603; TCU 0805; TCA 1206

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types:	
			TCT 0603	10 Ω to 1 MΩ
			TCU 0805	10 Ω to 1 MΩ
			TCA 1206	10 Ω to 1 MΩ
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	125 °C; 16 h	
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; 90 to 100 % R; 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	±0,25% no visible damage
–	1 (Aa)	cold	−55 °C; 2 h	±0,25%
4.13	–	short time overload	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±0,25% no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±0,25%
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 ±5 °C; 10 ±1 s	±0,25% no visible damage
4.17.2	20 (Ta)	solderability	+215 °C; 3 s solder bath method	good tinning (≥ 95% covered); no visible damage
4.32	21 (Ue_3)	shear (adhesion)	5 N; 10 s	no visible damage
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown

Note

1. All given figures are valid for the untrimmed resistor.

High frequency flat chip resistor MCT 0603 HF

FEATURES

- Speciality product for RF applications
- Low-inductance trimmed product
- Suitable for more than 10 GHz
- Resistance range: 6,8 Ω to 470 Ω
- Size:
  - Imperial: 0603
  - Metric: RR 1608M

APPLICATIONS

- Telecommunication equipment
- Industrial electronics

DESCRIPTION

MCT 0603 HF speciality thin film flat chip resistors for RF applications is 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.

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 (96% Al_2O_3) ceramic body and conditioned to achieve the desired temperature coefficient. Specially designed pre-contacts are deposited on both sides using the same thin film technology. A special laser is used to achieve the target value by smoothly cutting a groove - with a resulting low inductivity - in the resistive layer without damaging the ceramics. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure performed on 100% of the individual chip resistors. Only accepted products are laid directly into the paper tape in accordance with **IEC 60286-3**.

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

Where applicable, the resistors are tested in accordance with **CECC 40401-801** which refers to **EN 140000** **(IEC 60115-1)** and **EN 140400 (IEC 60115-8)**.

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

High frequency flat chip resistor MCT 0603 HF

QUICK REFERENCE DATA

DESCRIPTION	MCT 0603 HF	
Metric size	RR 1608M	
Resistance range	6,8 Ω to 470 Ω; 50 Ω	
Resistance tolerance	±2%	
Temperature coefficient	±50 ppm/K	
Operation mode	standard	power
Climatic category (LCT/UCT/days)	55/125/56	55/155/56
Rated dissipation, P_{70}	0,1 W	0,125 W
Operating voltage, U_{max} AC/DC	75 V	
Film temperature	125 °C	155 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	6,8 Ω to 470 Ω	
1000 h	≤ 0,5%	≤ 1,0%
8000 h	≤ 1,0%	≤ 2,0%
225000 h	≤ 3,0%	–
Specified lifetime	225000 h	8000 h
Permissible voltage against ambient:		
1 minute	100 V	
continuous	75 V	
Failure rate	$\leq 2{,}0 \times 10^{-9}$/h	

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE(1)
T.C.	TOLERANCE	MCT 0603 HF
±50 ppm/K	±2%	6,8 Ω to 470 Ω; 50 Ω

Note

1. Resistance values to be selected from E24 series.

High frequency flat chip resistor MCT 0603 HF

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312		
			CARDBOARD TAPE ON REEL		
TYPE	T.C.	TOL.	**P1 1 000 units**	**P5 5 000 units**	**PW 20 000 units**
MCT 0603 HF	±50 ppm/K	±2%	203 0....	**218 0....**	208 0....

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

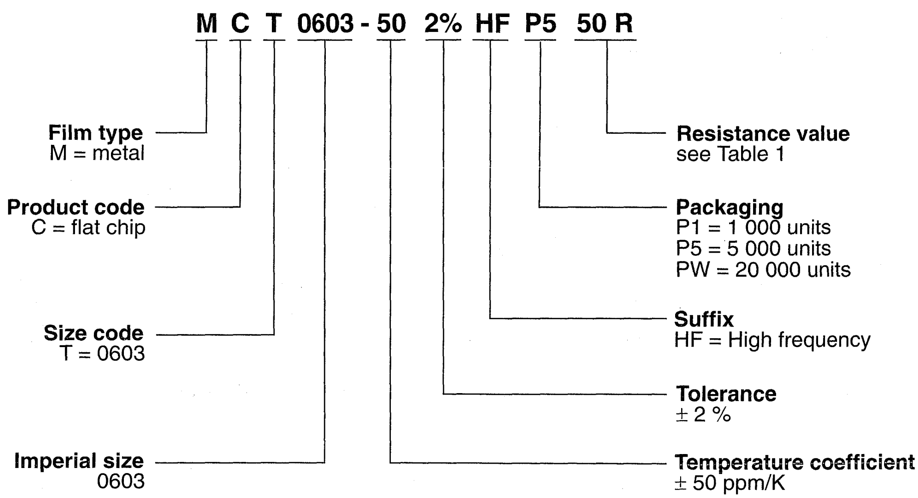
RESISTANCE DECADE	LAST DIGIT
1 Ω to 9,99 Ω	8
10 Ω to 99,9 Ω	9
100 Ω to 999 Ω	1

ORDERING EXAMPLE

The ordering code of a MCT 0603 HF resistor, value 50 Ω and TC 50 with ±2% tolerance, supplied in cardboard tape of 5000 units per reel is: 2312 218 05009.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



High frequency flat chip resistor MCT 0603 HF

FUNCTIONAL DESCRIPTION

Derating

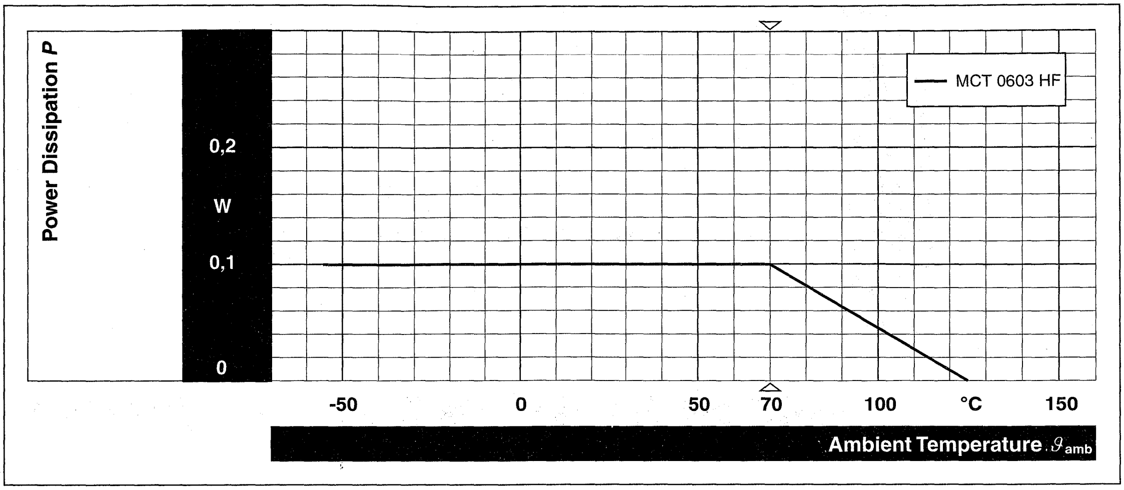


Fig.1 Derating, standard operation.

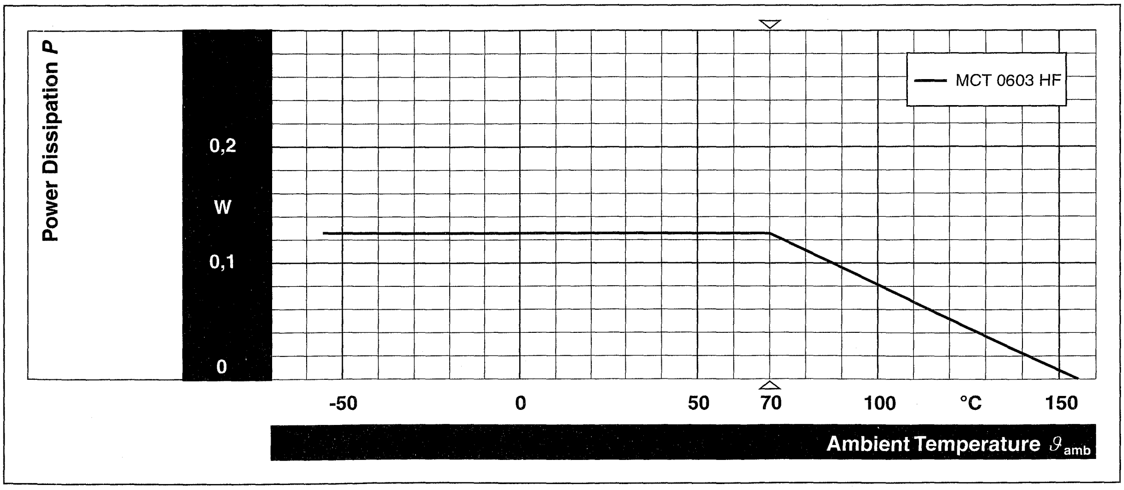


Fig.2 Derating, power operation.

RF-behaviour

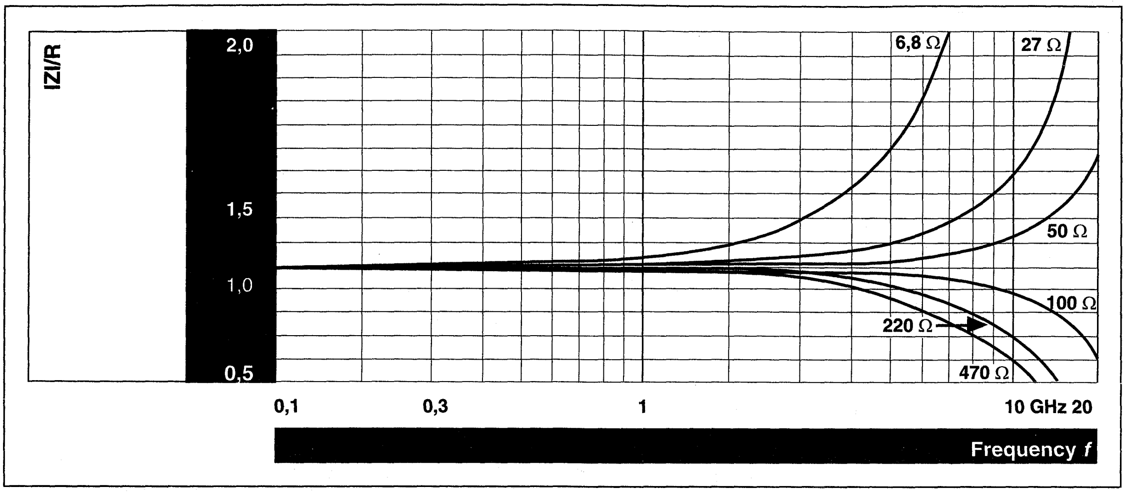
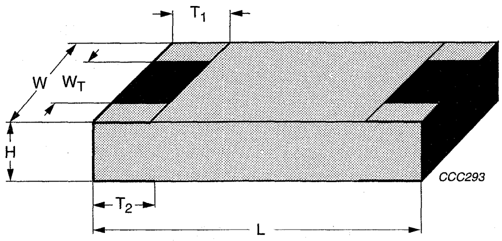


Fig.3 IZI/R for MCT 0603 HF.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.4 Outlines.

Table 4 Chip resistor types, mass and relevant physical dimensions; see Fig.4

TYPE	H (mm)	L (mm)	W (mm)	W_T (mm)	T_1 (mm)	T_2 (mm)	MASS (mg)
MCT 0603 HF	0,45 +0,1/−0,05	1,55 ±0,05	0,85 ±0,1	> 75% of W	0,3 +0,15/−0,2	0,3 +0,15/−0,2	1,5

High frequency flat chip resistor MCT 0603 HF

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 140400 / IEC 60115-8, Sectional specification (includes schedule for qualification approval)

CECC 40401-801, Detail specification (includes schedule for conformance inspection)

Table 5 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types: MCT 0603 HF	6,8 Ω to 470 Ω
4.5	–	resistance		±2%
4.8.4.2	–	temperature coefficient	at 20 / LCT / 20 °C and 20 / UCT / 20 °C	±50 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; 1 000 h 70 °C; 8000 h	 ±(0,5% + 0,05 Ω) ±(1% + 0,05 Ω)
4.25.3	–	endurance at upper category temperature	125 °C; 1 000 h	±(1% + 0,05 Ω)
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±(1% + 0,05 Ω)

High frequency flat chip resistor **MCT 0603 HF**

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types: MCT 0603 HF	6,8 Ω to 470 Ω
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	125 °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 to 35 °C	
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	±(1% + 0,05 Ω) no visible damage
–	1 (Aa)	cold	−55 °C; 2 h	±(0,5% + 0,05 Ω)
4.13	–	short time overload	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±(0,5% + 0,05 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±(0, % + 0,05 Ω) 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 ±5 °C; 10 ±1 s	±(1% + 0,05 Ω) no visible damage
4.17.2	20 (Ta)	solderability	+215 °C; 3 s solder bath method	good tinning (≥ 95% covered); no visible damage
4.32	21 (Ue_3)	shear (adhesion)	5 N; 10 s	no visible damage
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown

MELF RESISTOR PRODUCT DATA

Professional MELF resistors

MMU 0102; MMA 0204; MMB 0207

FEATURES

- Advanced thin film technology
- Power dissipation rating up to 1 W
- Excellent overall stability: Class 0,25
- Wide professional range: 0,1 Ω to 10 MΩ
- Metric sizes:
  - DIN: 0102; 0204; 0207
  - CECC: RC 2211M; RC 3715M; RC 6123M

APPLICATIONS

- Automotive
- Telecommunication
- Industrial
- Medical equipment.

DESCRIPTION

MMU 0102, MMA 0204 and MMB 0207 professional thin film MELF resistors are the perfect choice for most fields of modern professional electronics where reliability and stability is of major concern. The typical applications in the fields of automotive, telecommunication and medical equipment reflect the outstanding level of proven reliability.

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, for MICRO-MELF: 96% 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 helical groove in the resistive layer without damaging the ceramics. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating. 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 laid directly into the blister tape in accordance with **IEC 60286-3** or bulk case in accordance with **IEC 60286-6**.

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with **CECC 40401-803** which refers to **EN 140000** (**IEC 60115-1**) and **EN 140400 (IEC 60115-8).**

BCcomponents BEYSCHLAG has achieved **"Approval of Manufacturer"** in accordance with **EN 100114-1**. The release certificate for **"Technology Approval Schedule"** in accordance with **CECC 240001** based on **EN 100114-6** is granted for the BCcomponents BEYSCHLAG manufacturing process.

This product family of thin film MELF resistors is completed by **Zero Ohm Jumpers**.

On request, resistors are available with established reliability in accordance with **CECC 40401-803 Version E**.

QUICK REFERENCE DATA

DESCRIPTION	MMU 0102		MMA 0204		MMB 0207	
CECC size	RC 2211M		RC 3715M		RC 6123M	
Resistance range	0,22 Ω to 2,21 MΩ		0,22 Ω to 10 MΩ		0,1 Ω to 8,2 MΩ	
Resistance tolerance	±5%; ±2%; ±1%; ±0,5%					
Temperature coefficient	±50 ppm/K; ±25 ppm/K				±100 ppm/K; ±50 ppm/K; ±25 ppm/K	
Operation mode	standard	power	standard	power	standard	power
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}	0,2 W	0,3 W	0,25 W	0,4 W	0,4 W	1,0 W
Operating voltage, U_{max} AC/DC	150 V		200 V		300 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:	0,22 Ω to 221 kΩ		0,22 Ω to 332 kΩ		0,22 Ω to 1 MΩ	
1000 h	≤ 0,25%	≤ 0,5%	≤ 0,25%	≤ 0,5%	≤ 0,25%	≤ 0,5%
8000 h	≤ 0,5%	≤ 1,0%	≤ 0,5%	≤ 1,0%	≤ 0,5%	≤ 1,0%
225000 h	≤ 1,5%	–	≤ 1,5%	–	≤ 1,5%	–
Specified lifetime	225000 h	8000 h	225000 h	8000 h	225000 h	8000 h
Permissible voltage against ambient :						
1 minute	200 V		300 V		500 V	
continuous	75 V		75 V		75 V	
Failure rate	$\leq 2 \times 10^{-9}$/h		$\leq 0,7 \times 10^{-9}$/h		$\leq 0,7 \times 10^{-9}$/h	

Professional MELF resistors

MMU 0102; MMA 0204; MMB 0207

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[1]		
T.C.	**TOLERANCE**	**MMU 0102**	**MMA 0204**	**MMB 0207**
±100 ppm/K	±5%	–	–	0,1 Ω to 0,2 Ω
±50 ppm/K	±5%	0,22 Ω to 0,91 Ω	0,22 Ω to 0,91 Ω	0,22 Ω to 0,91 Ω
	±2%	1 Ω to 9,1 Ω	–	0,22 Ω to 0,91 Ω[2]
	±1%	**10 Ω to 2,21 MΩ**	**1 Ω to 10 MΩ**	**1 Ω to 8,2 MΩ**
	±0,5%	47 Ω to 221 kΩ	10 Ω to 475 kΩ	–
±25 ppm/K	±1%	10 Ω to 221 kΩ	10 Ω to 475 kΩ	–
	±0,5%	**47 Ω to 221 kΩ**	**10 Ω to 475 kΩ**	**10 Ω to 1 MΩ**
Jumper	–	**≤ 10 mΩ; I_{max} = 2A**	**≤ 10 mΩ, I_{max} = 3A**	**≤ 10 mΩ; I_{max} = 5A**

Notes

1. Resistance values to be selected for ±5% and ±2% tolerance from E24, for ±1% tolerance from E24 and E96 and for ±0,5% tolerance from E24 and E192.
2. Available on request.

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Professional MELF resistors

MMU 0102; MMA 0204; MMB 0207

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 3.
- 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 Table 4.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312					
			BLISTER TAPE ON REEL				BULK CASE	
TYPE	T.C.	TOL.	B2 2000 units	BL 3000 units	B7 7000 units	B0 10000 units	M3 3000 units	M8 8000 units
MMU 0102	±50 ppm/K	±5%	–	165 3....	–	175 3....	–	060 3....
		±2%	–	165 2....	–	175 2....	–	060 2....
		±1%	–	**165 1....**	–	**175 1....**	–	**060 1....**
		±0,5%	–	165 5....	–	175 5....	–	060 5....
	±25 ppm/K	±1%	–	166 1....	–	176 1....	–	061 1....
		±0,5%	–	**166 5....**	–	**176 5....**	–	**061 5....**
	jumper	–	–	**165 90001**	–	**175 90001**	–	**060 90001**
MMA 0204	±50 ppm/K	±5%	–	155 3....	–	145 3....	040 3....	–
		±1%	–	**155 1....**	–	**145 1....**	**040 1....**	–
		±0,5%	–	155 5....	–	145 5....	040 5....	–
	±25 ppm/K	±1%	–	156 1....	–	146 1....	041 1....	–
		±0,5%	–	**156 5....**	–	**146 5....**	**041 5....**	–
	jumper	–	–	**155 90001**	–	**145 90001**	**040 90001**	–

DESCRIPTION			ORDERING CODE 2312					
			BLISTER TAPE ON REEL				BULK CASE	
TYPE	T.C.	TOL.	**B2 2000 units**	**BL 3000 units**	**B7 7000 units**	**B0 10000 units**	**M3 3000 units**	**M8 8000 units**
MMB 0207: ≤0,2 Ω	±100 ppm/K	±5%	195 3....	–	185 3....	–	–	–
MMB 0207: >0,2 Ω	±50 ppm/K	±5%	195 3....	–	185 3....	–	–	–
		±2%	195 2....	–	185 2....	–	–	–
		±1%	**195 1....**	–	**185 1....**	–	–	–
MMB 0207	±25 ppm/K	±0,5%	**196 5....**	–	**186 5....**	–	–	–
	jumper	–	**195 90001**	–	**185 90001**	–	–	–

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

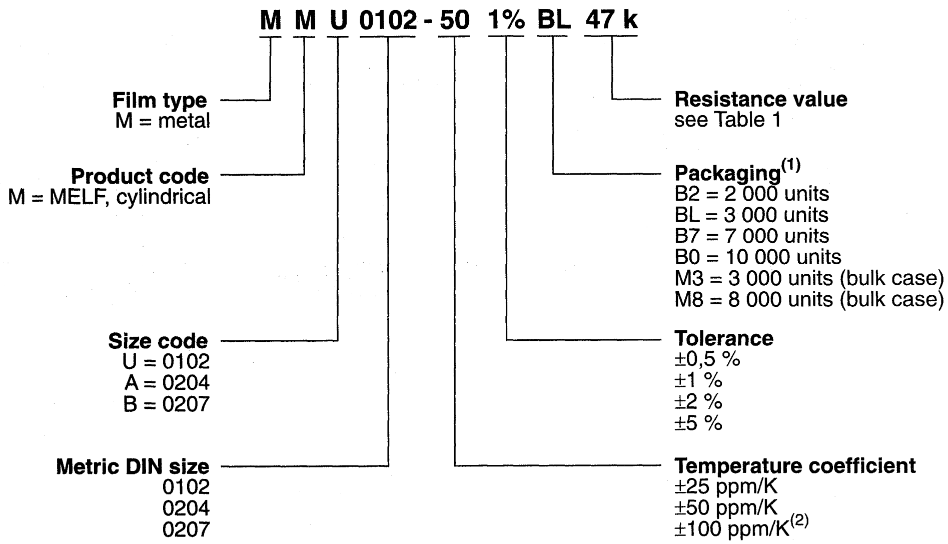
RESISTANCE DECADE	LAST DIGIT
0,1 Ω to 0,999 Ω	7
1 Ω to 9,99 Ω	8
10 Ω to 99,9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9,99 kΩ	2
10 kΩ to 99,9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9,99 MΩ	5
10 MΩ to 99,9 MΩ	6

ORDERING EXAMPLE

The ordering code of a MMU 0102 resistor, value 47 kΩ and TC 50 with ±1% tolerance, supplied in blister tape of 3000 units per reel is: 2312 165 14703.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



Jumpers are ordered by the resistance value 0 Ω, e.g. MMA 0204 BL 0R0.

(1) Availability in accordance with Table 2.

(2) A temperature coefficient 100 is marked -00.

FUNCTIONAL DESCRIPTION

Derating

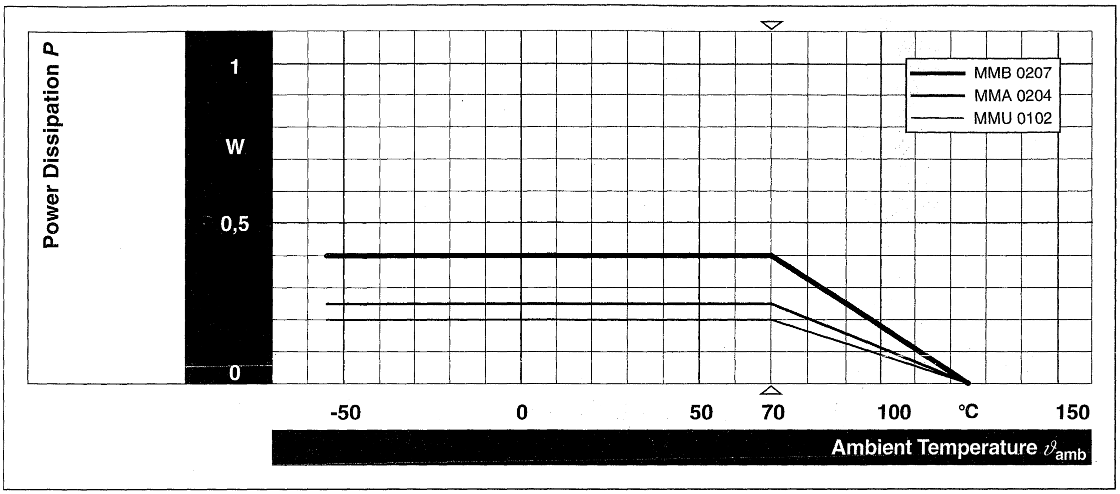


Fig.1 Derating, standard operation.

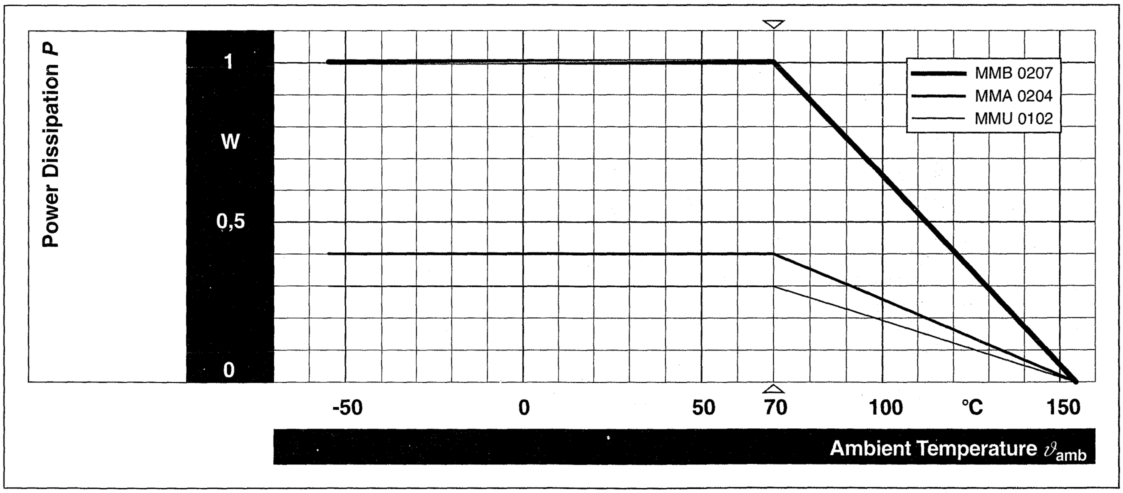


Fig.2 Derating, power operation.

Single pulse

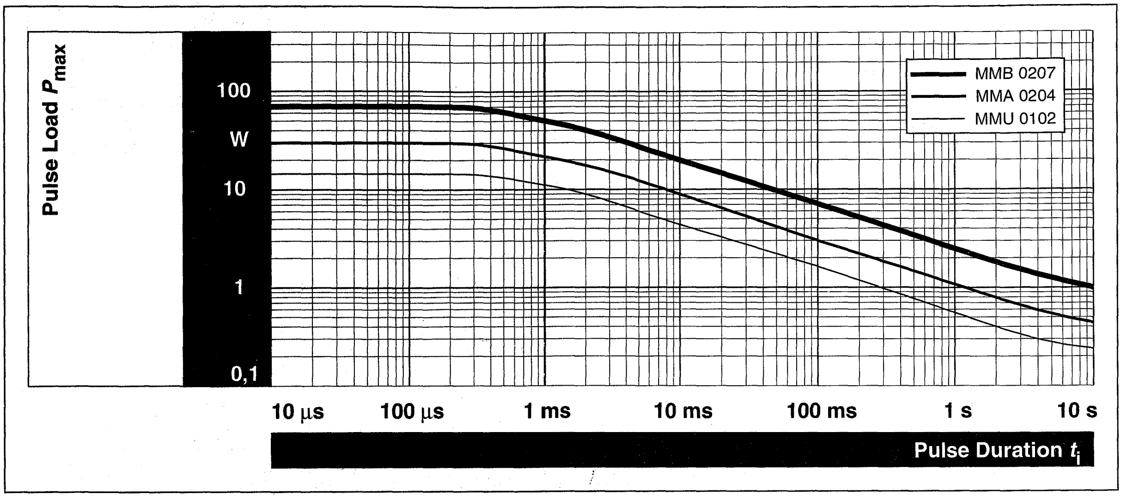


Fig.3 Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation.

Continuous pulses

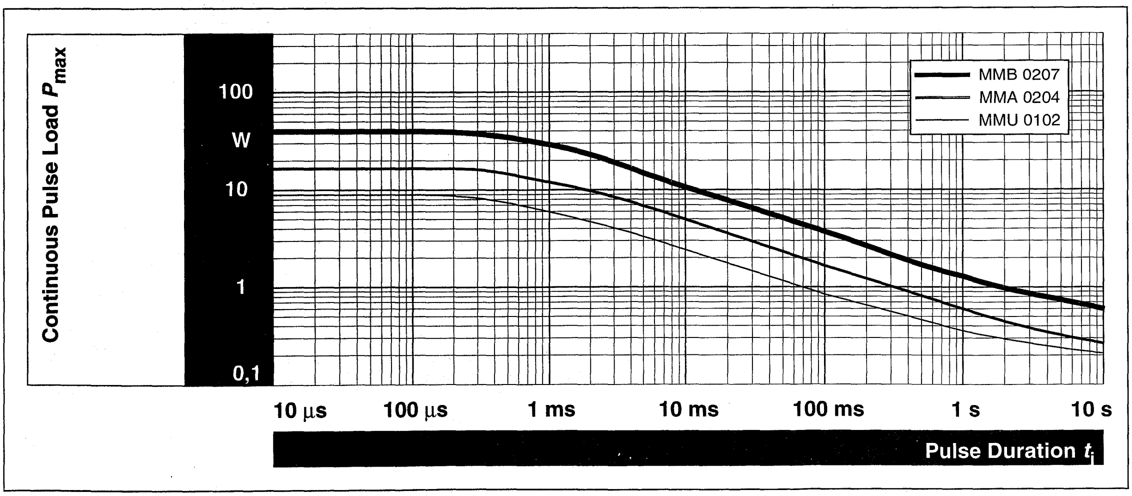


Fig.4 Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Pulse voltage

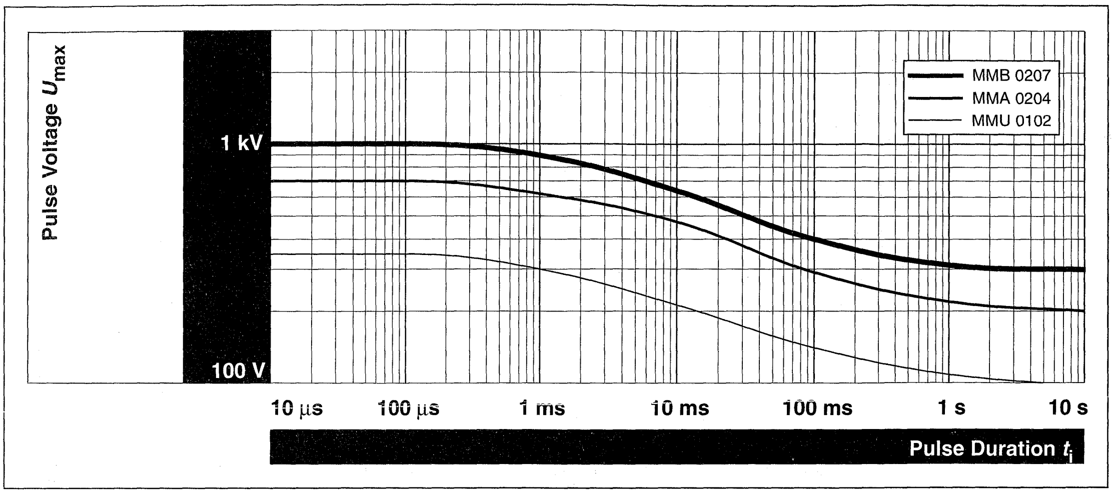


Fig.5 Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation.

1,2/50 pulse

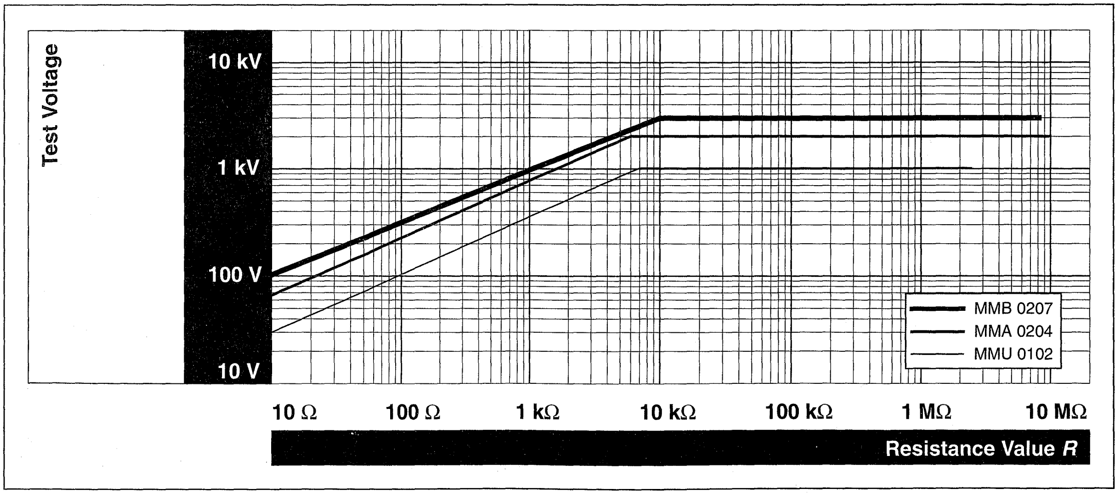


Fig.6 Pulse load rating in accordance with IEC 60115-1 clause 4.27; 1,2 µs / 50 µs; 5 pulses at 12 s intervals; for permissible resistance change 0,5%.

Professional MELF resistors

MMU 0102; MMA 0204; MMB 0207

10/700 pulse

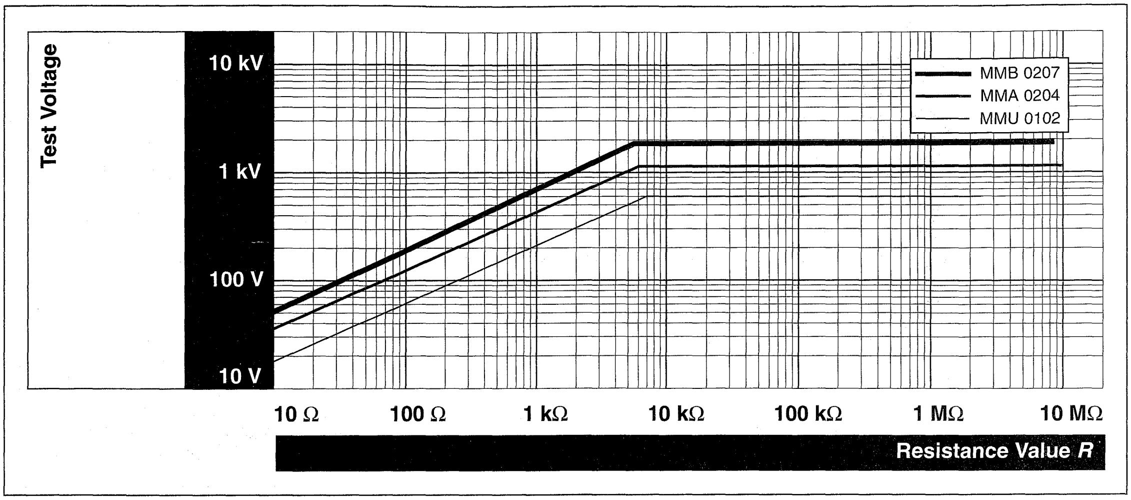


Fig.7 Pulse load rating in accordance with IEC 60115-1 clause 4.27; 10 μs / 700 μs; 10 pulses at 1 minute intervals; for permissible resistance change 0,5%.

Current noise

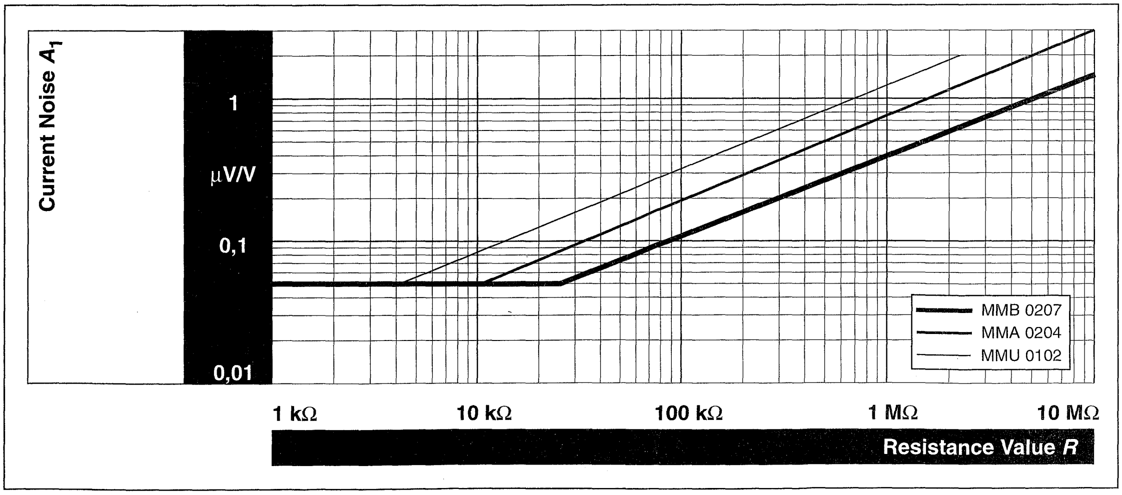


Fig.8 Current Noise A_1 in accordance with IEC 60195.

RF-behaviour

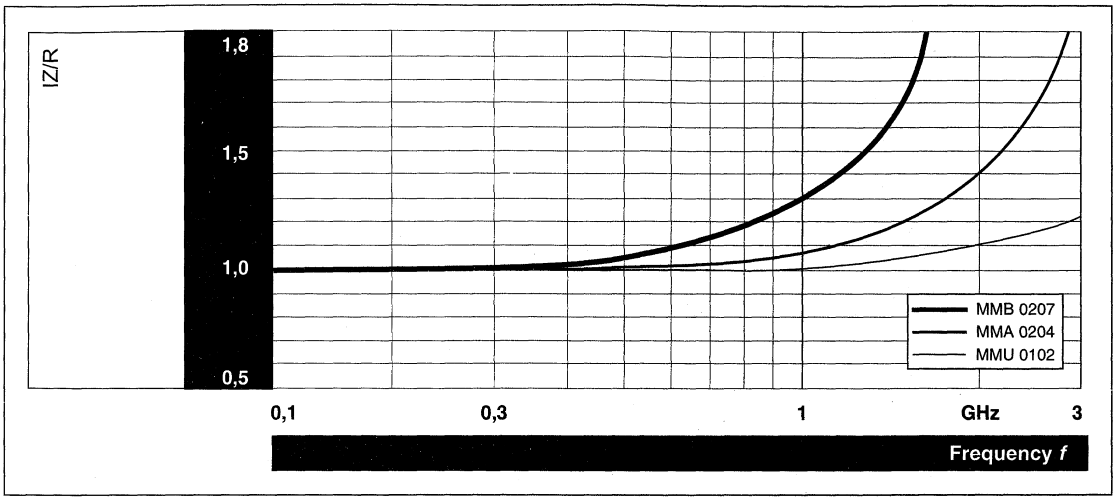
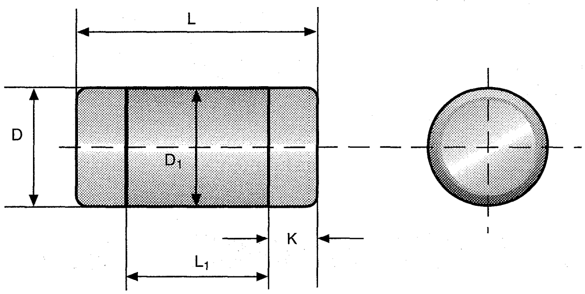


Fig.9 $|Z|/R$ for 49,9 Ω MELF resistor.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.10 Outlines.

Table 4 MELF resistor types, mass and relevant physical dimensions; see Fig.10

TYPE	L (mm)	D (mm)	$L_{1\ min}$ (mm)	D_1 (mm)	K (mm)	MASS (mg)
MMU 0102	2,2 +0/–0,1	1,1 +0/–0,1	1,2	D +0/–0,04	0,4 ±0,05	7
MMA 0204	3,6 +0/–0,2	1,4 +0/–0,1	1,8	D +0/–0,15	0,8 ±0,1	19
MMB 0207	5,8 +0/–0,2	2,2 +0/–0,2	2,8	D +0/–0,2	1,2 ±0,2	79

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 140400 / IEC 60115-8, Sectional specification (includes schedule for qualification approval)

CECC 40401-803, Detail specification (includes schedule for conformance inspection)

Most of the components are approved in accordance with the European CECC-system, where applicable. Table 5 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)			
				STABILITY CLASS 0,25	STABILITY CLASS 0,5	STABILITY CLASS 1	STABILITY CLASS 2
			stability for product types:				
			MMU 0102	10 Ω to221 kΩ	1 Ω to < 10 Ω	< 1 Ω	> 221 kΩ
			MMA 0204	10 Ω to332 kΩ	1 Ω to < 10 Ω	< 1 Ω	> 332 kΩ
			MMB 0207	10 Ω to 1 MΩ	1 Ω to < 10 Ω	< 1 Ω	> 1 MΩ
4.5	–	resistance	–	±1%; ±0,5%	±2%; ±1%	±5%; ±2%	±1%
4.8.4.2	–	temperature coefficient	at 20 / −55 / 20 °C and 20 / 125 / 20 °C	±50 ppm/K; ±25 ppm/K			
4.25.1	–	endurance; standard operation mode	room temperature; $U = \sqrt{P_{70} \times R} \leq U_{max}$; 1,5 h on; 0,5 h off;				
			70 °C; 1000 h	±(0,25% + 0,05 Ω)	±(0,25% + 0,05 Ω)	±(0,25% + 0,05 Ω)	±(0,5% + 0,05 Ω)
			70 °C; 8000 h	±(0,5% + 0,05 Ω)	±(0,5% + 0,05 Ω)	±(0,5% + 0,05 Ω)	±(1% + 0,05 Ω)

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)			
				STABILITY CLASS 0,25	**STABILITY CLASS 0,5**	**STABILITY CLASS 1**	**STABILITY CLASS 2**
			stability for product types:				
			MMU 0102	10Ω to 221 kΩ	1 Ω to < 10 Ω	< 1 Ω	> 221 kΩ
			MMA 0204	10Ω to 332 kΩ	1 Ω to < 10 Ω	< 1 Ω	> 332 kΩ
			MMB 0207	10 Ω to 1 MΩ	1 Ω to < 10 Ω	< 1 Ω	> 1 MΩ
4.25.1 (cont.)	–	endurance; power operation mode	room temperature; $U = \sqrt{P_{70} \times R} \leq U_{max}$; 1,5 h on; 0,5 h off;				
			70 °C; 1 000 h	±(0,25% + 0,05 Ω)	±(0,5% + 0,05 Ω)	±(0,5% + 0,05 Ω)	±(1% + 0,05 Ω)
			70 °C; 8 000 h	±(0,5% + 0,05 Ω)	±(1% + 0,05 Ω)	±(1% + 0,05 Ω)	±(2% + 0,05 Ω)
4.25.3	–	endurance at upper category temperature	125 °C; 1 000 h	±(0,25% + 0,05 Ω)	±(0,5% + 0,05 Ω)	±(1% + 0,05 Ω)	+(2% 0,05 Ω); –(0,5% 0,05 Ω)
			155 °C; 1 000 h	±(0,25% + 0,05 Ω)	±(1% + 0,05 Ω)	±(2% + 0,05 Ω)	+(2% +0,05 Ω); –(0,5% +0,05 Ω)
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±(0,25% + 0,05 Ω)	±(0,5% + 0,05 Ω)	±(1% + 0,05 Ω)	±(2% + 0,1 Ω)
4.23		climatic sequence:					
4.23.2	2 (Ba)	dry heat	UCT; 16 h				
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90% RH; 1 cycle				
4.23.4	1 (Aa)	cold	LCT; 2 h				
4.23.5	13 (M)	low air pressure	8,5 kPa; 2 h; 25 ±10 °C				
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90% RH; 5 cycles				
			LCT = –55 °C; UCT = 155 °C	±(0,25% + 0,05 Ω) no visible damage	±(0,5% + 0,05 Ω) no visible damage	±(1% + 0,05 Ω) no visible damage	±(2% + 0,1 Ω) no visible damage

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)			
				STABILITY CLASS 0,25	STABILITY CLASS 0,5	STABILITY CLASS 1	STABILITY CLASS 2
			stability for product types:				
			MMU 0102	10 Ω to221 kΩ	1Ω to < 10Ω	< 1 Ω	> 221 kΩ
			MMA 0204	10 Ω to332 kΩ	1Ω to < 10Ω	< 1 Ω	> 332 kΩ
			MMB 0207	10 Ω to 1 MΩ	1Ω to < 10Ω	< 1 Ω	> 1 MΩ
–	1 (Aa)	cold	−55 °C; 2 h	±(0,05% + 0,01 Ω)	±(0,1% + 0,01 Ω)	±(0,25% + 0,05 Ω)	±(0,5% + 0,05 Ω)
4.13	–	short time overload; standard operation mode	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ $\leq 2 \times U_{max}$; 5 s	±(0,05% + 0,01 Ω) no visible damage	±(0,1% + 0,01 Ω) no visible damage	±(0,25% + 0,05 Ω) no visible damage	±(0,5% + 0,05 Ω) no visible damage
		short time overload; power operation mode	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ $\leq 2 \times U_{max}$; 5 s	±(0,05% + 0,01 Ω) no visible damage	±(0,1% + 0,01 Ω) no visible damage	±(0,25% + 0,05 Ω) no visible damage	±(0,5% + 0,05 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at −55 °C; 30 minutes at +155°C; 5 cycles	±(0,05% + 0,01 Ω) no visible damage	±(0,1% + 0,01 Ω) no visible damage	±(0,25% + 0,05 Ω) no visible damage	±(0,5% + 0,05 Ω) no visible damage
4.29	45 (XA)	component solvent resistance	isopropyl alcohol; +23 °C; toothbrush method	marking legible; no visible damage			
4.18.2	58 (Td)	resistance to soldering heat	solder bath method; 260 ±5 °C; 10 ±1 s	±(0,05% + 0,01 Ω) no visible damage	±(0,1% + 0,01 Ω) no visible damage	±(0,25% + 0,05 Ω) no visible damage	±(0,5% + 0,05 Ω) no visible damage
4.17.2	58 (Td)	solderability	solder bath method; 215 °C; 3 s	good tinning (≥ 95% covered); no visible damage			
4.32	21 (Ue_3)	shear (adhesion)	5 N; 10 s	no visible damage			
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown			

Precision MELF resistors

MMU 0102; MMA 0204; MMB 0207

FEATURES

- Advanced thin film technology
- Lowest TC: 15 to 25 ppm/K
- Precision tolerance of value: ±0,1 and ±0,25%
- Superior overall stability: Class 0,05
- Wide precision range: 15 Ω to1 MΩ
- Metric sizes:
  - DIN: 0102; 0204; 0207
  - CECC: RC 2211M; RC 3715M; RC 6123M

APPLICATIONS

- Test and measuring equipment
- Industrial and medical electronics.

DESCRIPTION

MMU 0102, MMA 0204 and MMB 0207 precision thin film MELF 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.

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, for MICRO-MELF: 96% 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 helical groove in the resistive layer without damaging the ceramics. A further conditioning is applied in order to stabilise the trimming result. The resistor elements are covered by a 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 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 laid directly into the blister tape in accordance with **IEC 60 286-3**.

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with **CECC 40401-803** which refers to **EN 140000 (IEC 60115-1)** and **EN 140400 (IEC 60 115-8).**

BCcomponents BEYSCHLAG has achieved **"Approval of Manufacturer"** in accordance with **EN 100114-1**. The release certificate for **"Technology Approval Schedule"** in accordance with **CECC 240001** based on **EN 100114-6** is granted for the BCcomponents BEYSCHLAG manufacturing process.

On request, resistors are available with established reliability in accordance with **CECC 40 401-803 Version E**.

Precision MELF resistors

MMU 0102; MMA 0204; MMB 0207

QUICK REFERENCE DATA

DESCRIPTION	MMU 0102		MMA 0204		MMB 0207	
Metric CECC size	RC 2211M		RC 3715M		RC 6123M	
Resistance range	100 Ω to 221 kΩ		10 Ω to 332 kΩ		15 Ω to 1 MΩ	
Resistance tolerance	±0,25%; ±0,1%; ±0,5%				±0,25%; ±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}	0,06 W	0,2 W	0,07 W	0,25 W	0,11 W	0,4 W
Operating voltage, U_{max} AC/DC	150 V		200 V		300 V	
Film temperature	85 °C	125 °C	85 °C	125 °C	85 °C	125 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	100 Ω to 100 kΩ		100 Ω to 100 kΩ		100 Ω to 270 kΩ	
1000 h	≤ 0,05%	≤ 0,25%	≤ 0,05%	≤ 0,25%	≤ 0,05%	≤ 0,25%
8000 h	≤ 0,1%	≤ 0,5%	≤ 0,1%	≤ 0,5%	≤ 0,1%	≤ 0,5%
225000 h	≤ 0,3%	≤ 1,5%	≤ 0,3%	≤ 1,5%	≤ 0,3%	≤ 1,5%
Specified lifetime	225 000 h		225 000 h		225 000 h	
Permissible voltage against ambient:						
1 minute	200 V		300 V		500 V	
continuous	75 V		75 V		75 V	
Failure rate	$\leq 2{,}0 \times 10^{-9}$/h		$\leq 0{,}7 \times 10^{-9}$/h		$\leq 0{,}7 \times 10^{-9}$/h	

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[1]		
T.C.	**TOLERANCE**	**MMU 0102**	**MMA 0204**	**MMB 0207**
±25 ppm/K	±0,25%	**100 Ω to 221 kΩ**	**22 Ω to 332 kΩ**	**15 Ω to 1 MΩ**
	±0,1%	**100 Ω to 100 kΩ**	**43 Ω to 332 kΩ**	**33 Ω to 1 MΩ**
±15 ppm/K	±0,5%	100 Ω to 100 kΩ	10 Ω to 221 kΩ	–
	±0,25%	100 Ω to 100 kΩ	22 Ω to 221 kΩ	–
	±0,1%	**100 Ω to 100 kΩ**	**43 Ω to 221 kΩ**	**33 Ω to 1 MΩ**

Note

1. Resistance values to be selected from E24 and E192 series, for other values please contact the factory.

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312						
			BLISTER TAPE ON REEL					BULK CASE	
TYPE	T.C.	TOL.	B1 1000 units	B2 2000 units	BL 3000 units	B7 7000 units	B0 10000 units	M3 3000 units	M8 8000 units
MMU 0102	±25 ppm/K	±0,25%	171 6....	–	**166 6....**	–	176 6....	–	061 6....
		±0,1%	171 7....	–	**166 7....**	–	176 7....	–	061 7....
	±15 ppm/K	±0,5%	172 5....	–	167 5....	–	177 5....	–	062 5....
		±0,25%	172 6....	–	167 6....	–	177 6....	–	062 6....
		±0,1%	172 7....	–	**167 7....**	–	177 7....	–	062 7....
MMA 0204	±25 ppm/K	±0,25%	141 6....	–	**156 6....**	–	146 6....	041 6....	–
		±0,1%	141 7....	–	**156 7....**	–	146 7....	041 7....	–
	±15 ppm/K	±0,5%	142 5....	–	157 5....	–	147 5....	042 5....	–
		±0,25%	142 6....	–	157 6....	–	147 6....	042 6....	–
		±0,1%	142 7....	–	**157 7....**	–	147 7....	042 7....	–
MMB 0207	±25 ppm/K	±0,25%	181 6....	**196 6....**	–	186 6....	–	–	–
		±0,1%	181 7....	**196 7....**	–	186 7....	–	–	–
	±15 ppm/K	±0,1%	182 7....	**197 7....**	–	187 7....	–	–	–

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

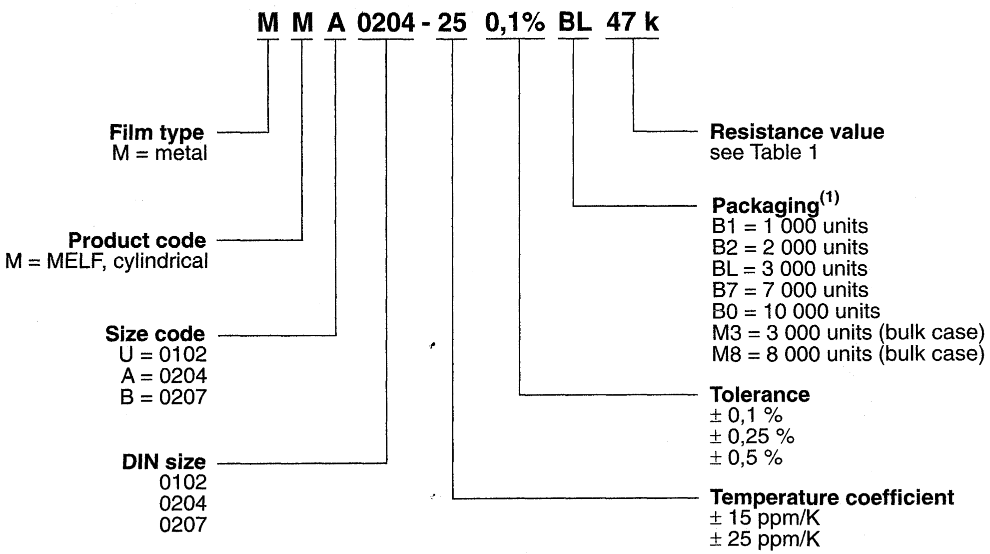
RESISTANCE DECADE	LAST DIGIT
1 Ω to 9,99 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9,99 kΩ	2
10 kΩ to 99,9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9,99 MΩ	5

ORDERING EXAMPLE

The ordering code of a MMA 0204 resistor, value 47 kΩ and TC 25 with ±0,1% tolerance, supplied in blister tape of 3000 units per reel is: 2312 156 74703.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



(1) Availability in accordance with Table 2.

Precision MELF resistors

MMU 0102; MMA 0204; MMB 0207

FUNCTIONAL DESCRIPTION

Derating

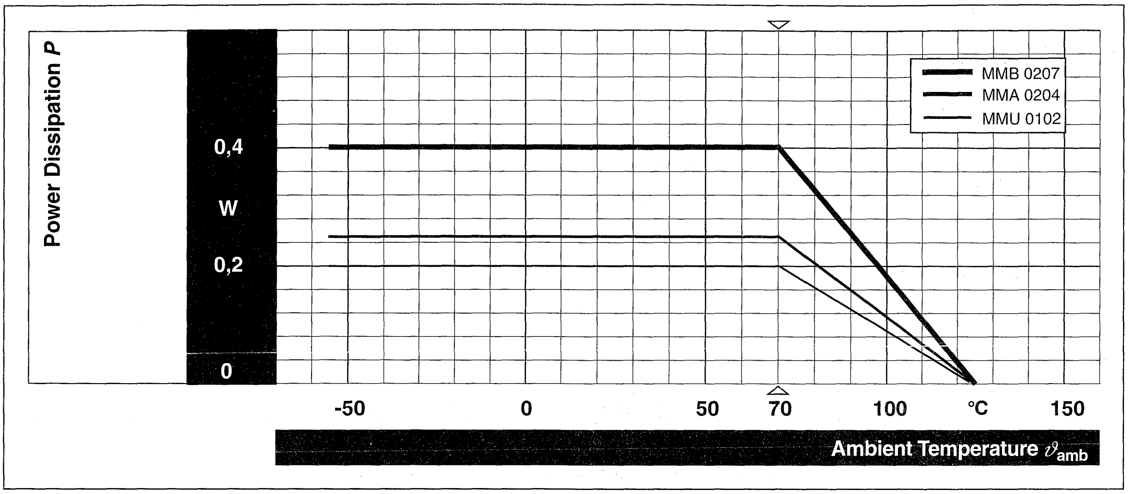


Fig.1 Derating, standard operation.

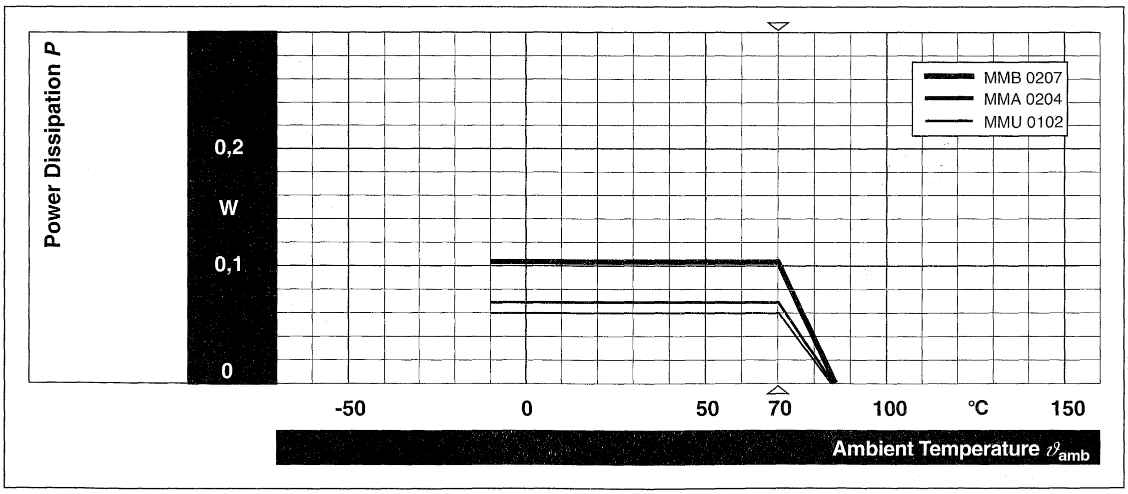


Fig.2 Derating, precision operation.

Current noise

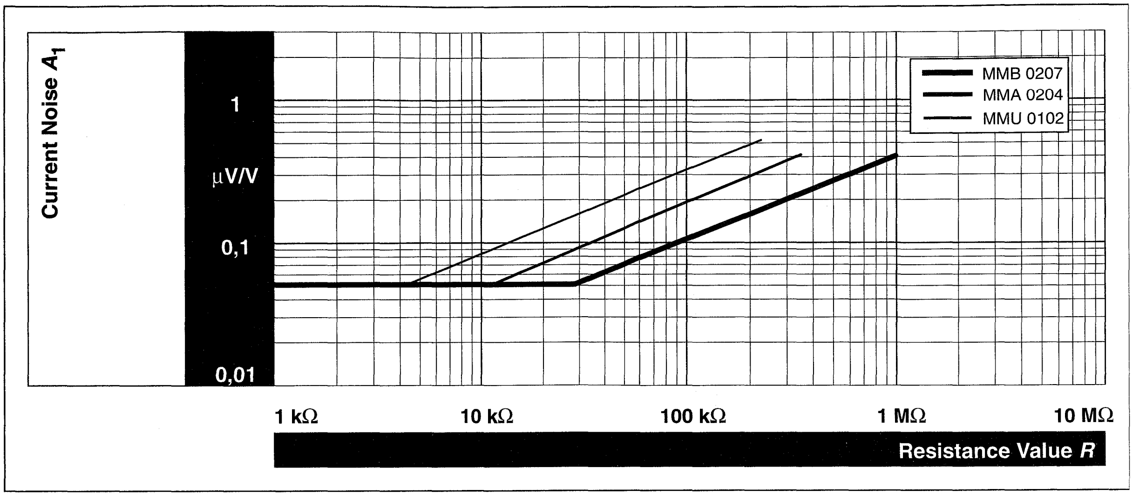
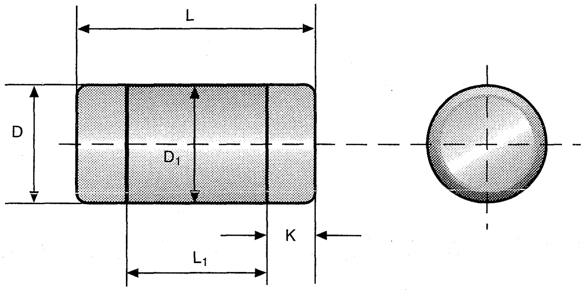


Fig.3 Current noise A_1 in accordance with IEC 60 195.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.4 Outlines.

Table 4 MELF resistor types, mass and relevant physical dimensions; see Fig.4

TYPE	L (mm)	D (mm)	$L_{1\,min}$ (mm)	D_1 (mm)	K (mm)	MASS (mg)
MMU 0102	2,2 +0/−0,1	1,1 +0/−0,1	1,2	D +0/−0,04	0,4 ±0,05	7
MMA 0204	3,6 +0/−0,2	1,4 +0/−0,1	1,8	D +0/−0,15	0,8 ±0,1	19
MMB 0207	5,8 +0/−0,2	2,2 +0/−0,2	2,8	D +0/−0,2	1,2 ±0,2	79

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 140400 / IEC 60115-8, Sectional specification (includes schedule for qualification approval)

CECC 40401-803, Detail specification (includes schedule for conformance inspection)

Most of the components are approved in accordance with the European CECC-system, where applicable. Table 5 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR/R)		
			stability for product types:	STABILITY CLASS 0,05	STABILITY CLASS 0,1	STABILITY CLASS 0,25
			MMU 0102	100 Ω to 100 kΩ	43 Ω to 147 kΩ	10 Ω to 221 kΩ
			MMA 0204	100 Ω to 100 kΩ	43 Ω to 221 kΩ	10 Ω to 332 kΩ
			MMB 0207	100 Ω to 270 kΩ	43 Ω to 510 kΩ	15 Ω to 1 MΩ
4.5	–	resistance	–	±0,5%; ±0,25%; ±0,1%		
4.8.4.2	–	temperature coefficient	at 20 / –55 / 20 °C and 20 / 125 / 20 °C	±25 ppm/K, ±15 ppm/K		
4.25.1	–	endurance; precision operation mode	room temperature; $U = \sqrt{P_{70} \times R} \leq U_{max}$; 1,5 h on; 0,5 h off;			
			70 °C; 1000 h	±(0,05% + 10 mΩ)	±(0,1% + 10 mΩ)	–
			70 °C; 8000 h	±(0,1% + 10 mΩ)	±(0,2% + 10 mΩ)	–
		endurance; standard operation mode	room temperature; $U = \sqrt{P_{70} \times R} \leq U_{max}$; 1,5 h on; 0,5 h off;			
			70 °C; 1000 h	–	–	±(0,25% + 50 mΩ)
			70 °C; 8000 h	–	–	±(0,5% + 50 mΩ)

Precision MELF resistors

MMU 0102; MMA 0204; MMB 0207

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR/R)		
			stability for product types:	**STABILITY CLASS 0,05**	**STABILITY CLASS 0,1**	**STABILITY CLASS 0,25**
			MMU 0102	100 Ω to 100 kΩ	43 Ω to 147 kΩ	10 Ω to 221 kΩ
			MMA 0204	100 Ω to 100 kΩ	43 Ω to 221 kΩ	10 Ω to 332 kΩ
			MMB 0207	100 Ω to 270 kΩ	43 Ω to 510 kΩ	15 Ω to 1 MΩ
4.25.3	–	endurance at upper category temperature	85 °C; 1000 h 125 °C; 1000 h	±(0,05%+ 10 mΩ) –	±(0,1% + 10 mΩ) –	±(0,1% + 50 mΩ) ±(0,25% + 50 mΩ)
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±(0,05% + 10 mΩ)	±(0,1% + 10 mΩ)	±(0,25% + 50 mΩ)
4.23		climatic sequence:				
4.23.2	2 (Ba)	dry heat	UCT; 16 h			
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90% RH; 1 cycle			
4.23.4	1 (Aa)	cold	LCT; 2 h			
4.23.5	13 (M)	low air pressure	8,5 kPa; 2 h; 25 ± 10 °C			
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90% RH; 5 cycles			
			LCT = –10 °C; UCT = 85 °C	±(0,05% + 10 mΩ) no visible damage	±(0,1% + 10 mΩ) no visible damage	–
			LCT = –55 °C; UCT = 125 °C	–	–	±(0,25% + 50 mΩ) no visible damage
–	1 (Aa)	cold	–55 °C; 2 h	±(0,01% + 10 mΩ)	±(0,02% + 10 mΩ)	±(0,05% + 10 mΩ)
4.13	–	short time overload; standard operation mode	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ $\leq 2 \times U_{max}$; 5 s	±(0,01% + 10 mΩ) no visible damage	±(0,02% + 10 mΩ) no visible damage	±(0,05% + 10 mΩ) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at –55 °C; 30 minutes at 125 °C; 5 cycles	±(0,01% + 10 mΩ) no visible damage	±(0,02% + 10 mΩ) no visible damage	±(0,05% + 10 mΩ) no visible damage
4.29	45 (XA)	component solvent resistance	isopropyl alcohol; +23 °C; toothbrush method	marking legible; no visible damage		

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR/R)		
			stability for product types:	**STABILITY CLASS 0,05**	**STABILITY CLASS 0,1**	**STABILITY CLASS 0,25**
			MMU 0102	100 Ω to 100 kΩ	43 Ω to 147 kΩ	10 Ω to 221 kΩ
			MMA 0204	100 Ω to 100 kΩ	43 Ω to 221 kΩ	10 Ω to 332 kΩ
			MMB 0207	100 Ω to 270 kΩ	43 Ω to 510 kΩ	15 Ω to 1 MΩ
4.18.2	58 (Td)	resistance to soldering heat	solder bath method; 260 ±5 °C; 10 ±1 s	±(0,01% + 10 mΩ) no visible damage	±(0,02% + 10 mΩ) no visible damage	±(0,05% + 10 mΩ) no visible damage
4.17.2	58 (Td)	solderability	solder bath method; 215 °C; 3 s	good tinning (≥ 95% covered); no visible damage		
4.32	21 (Ue_3)	shear (adhesion)	5 N; 10 s	no visible damage		
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown		

Ultra precision MELF resistor UMA 0204

FEATURES

- Most advanced thin film technology
- Lowest T.C.: ±05 to ±15 ppm/K
- Ultra precision tolerance of value: ±0,02 to ±0,25%
- Superior overall stability
- Wide ultra precision range: 22 Ω to 221 kΩ
- Metric size:
  - DIN: 0204
  - CECC: RC 3715M

APPLICATIONS

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

DESCRIPTION

UMA 0204 ultra precision thin film MINI-MELF resistors combine the proven reliability of professional MELF products with a most advanced level of precision and stability first achieved with axial thin film ultra precision resistors. This unique combination makes the product perfectly suited for all applications with outstanding requirements towards reliable precision and stability.

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 stability. Nickel plated steel terminations are firmly pressed on the metallised rods. A special laser is used to achieve the target value by smoothly cutting in the resistive layer without damaging the ceramics. A further conditioning is applied in order to stabilise the trimming result. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating. Five colour rings designate the resistance value and tolerance in accordance with **IEC 60062**. Additional colour dots near the fourth ring are used to identify the temperature coefficient.

The result of the determined production is verified by an extensive testing procedure under strict temperature control, performed on 100% of the individual resistors. Only accepted products are laid directly into the antistatic blister tape in accordance with **IEC 60286-3**.

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

Where applicable, the resistors are tested in accordance with **CECC 40401-803** which refers to **EN 140000** (**IEC 60115-1**) and **EN 140400** (**IEC 60115-8**).

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

Ultra precision MELF resistor UMA 0204

QUICK REFERENCE DATA

DESCRIPTION	UMA 0204	
Metric CECC size	RC 3715M	
Resistance range	22 Ω to 221 kΩ	
Resistance tolerance	±0,25%; ±0,1%; ±0,05%; ±0,02%(1)	
Temperature coefficient	±15 ppm/K; ±10 ppm/K; ±05 ppm/K	
Operation mode	precision	standard
Climatic category (LCT/UCT/days)	10/85/56	55/125/56
Rated dissipation, P_{70}	0,07 W	0,25 W
Operating voltage, U_{max} AC/DC	200 V	
Film temperature	85 °C	125 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	100 Ω to 100 kΩ	
1000 h	≤ 0,02%	≤ 0,05%
8000 h	≤ 0,04%	≤ 0,1%
225000 h	≤ 0,12%	≤ 0,3%
Specified lifetime	225000 h	
Permissible voltage against ambient:		
1 minute	300 V	
continuous	75 V	
Failure rate	$\leq 0{,}7 \times 10^{-9}$/h	

Note

1. Tolerance ±0,02% available on request.

Ultra precision MELF resistor UMA 0204

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[1]
T.C.	**TOLERANCE**	**UMA 0204**
15 ppm/K	0,05%	47 Ω to 221 kΩ
10 ppm/K[2]	0,25%	22 Ω to 221 kΩ
	0,1%	43 Ω to 221 kΩ
	0,05%	100 Ω to 100 kΩ
05 ppm/K[2]	0,25%	100 Ω to 100 kΩ
	0,1%	100 Ω to 100 kΩ
	0,05%	100 Ω to 100 kΩ
	0,02%[3]	100 Ω to 100 kΩ

Notes

1. Resistance values to be selected from E192 series, for other values please contact the factory.
2. TC10 and TC05 is specified over the temperature range from –10 °C to +85 °C.
3. On request.

Ultra precision MELF resistor UMA 0204

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312			
			BULK[1]	ANTISTATIC BLISTER TAPE ON REEL		
TYPE	T.C.	TOL.	100 units	A1 1000 units	AL 3000 units	A0 10000 units
UMA 0204	±15 ppm/K	±0,05%	101 4....	106 4....	111 4....	116 4....
		note 2	101 91...	106 91...	111 91...	116 91...
	±10 ppm/K	±0,25%	102 3....	107 2....	112 2....	117 2....
		±0,1%	102 3....	107 3....	112 3....	117 3....
		±0,05%	102 4....	107 4....	112 4....	117 4....
		note 2	102 91...	107 91...	112 91...	117 91...
	±05 ppm/K	±0,25%	103 2....	108 2....	113 2....	118 2....
		±0,1%	103 3....	108 3....	113 3....	118 3....
		±0,05%	103 4....	108 4....	113 4....	118 4....
		±0,02%[3]	103 6....	108 6....	113 6....	118 6....
		note 2	103 91...	108 91...	113 91...	118 91...

Notes

1. Bulk products are available without packaging code in multiples of 100 units and delivered in blister tape length(s), loose in a plastic bag or container, according to availability.
2. Readable 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.
3. Available on request.

Ultra precision MELF resistor UMA 0204

Table 3 Last digit of 12NC indicating resistance decade

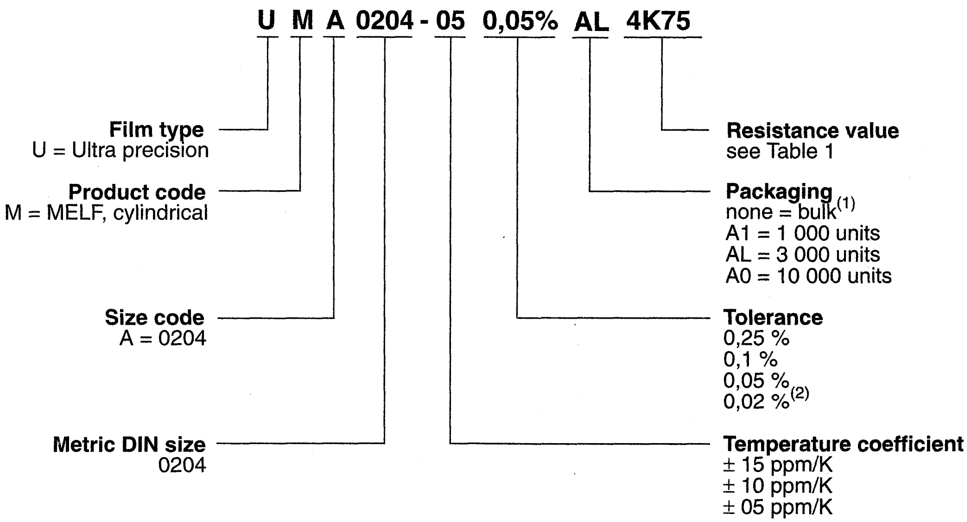
RESISTANCE DECADE	LAST DIGIT
100 to 999 Ω	1
1 to 9,99 kΩ	2
10 to 99,9 kΩ	3
100 to 999 kΩ	4

ORDERING EXAMPLE

The ordering code of an UMA 0204 resistor, value 4,75 kΩ and TC05 with ±0,05% tolerance, supplied in antistatic blister tape of 3 000 units per reel is: 2312 113 44752.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



(1) Bulk products are available without packaging code in multiples of 100 units and delivered in blister tape length(s), loose in bag or container.

(2) Available on request.

Ultra precision MELF resistor UMA 0204

FUNCTIONAL DESCRIPTION

Derating

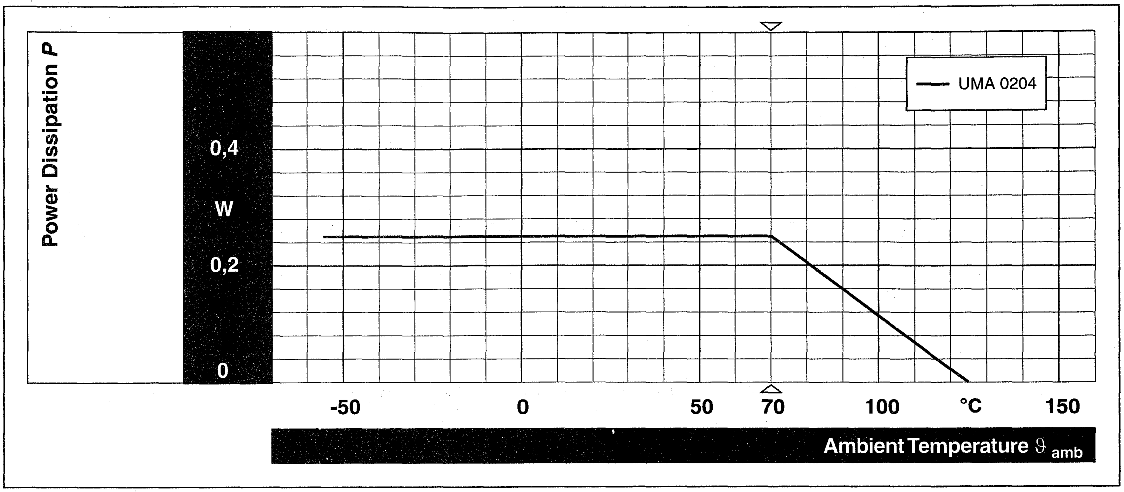


Fig.1 Derating, standard operation.

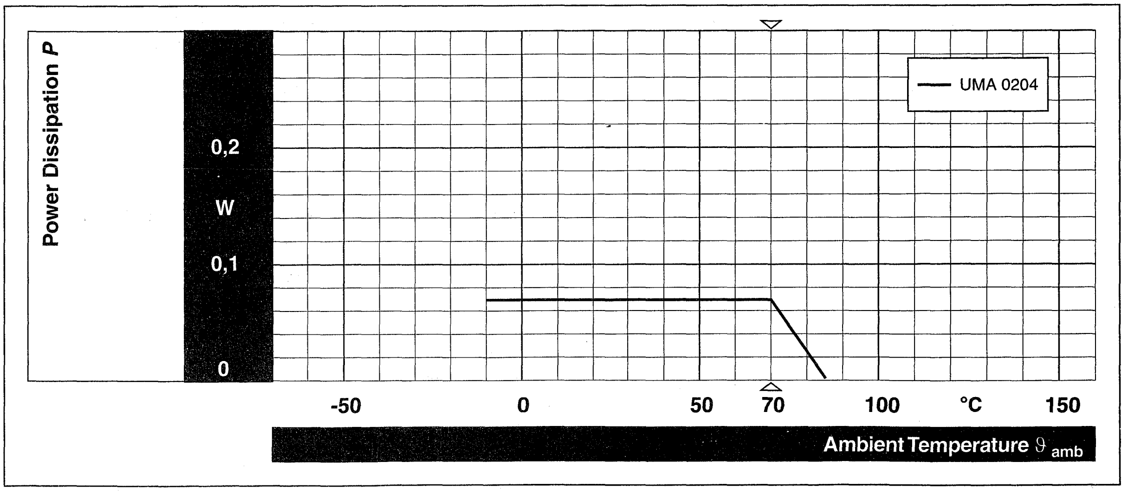


Fig.2 Derating, precision operation.

Current noise

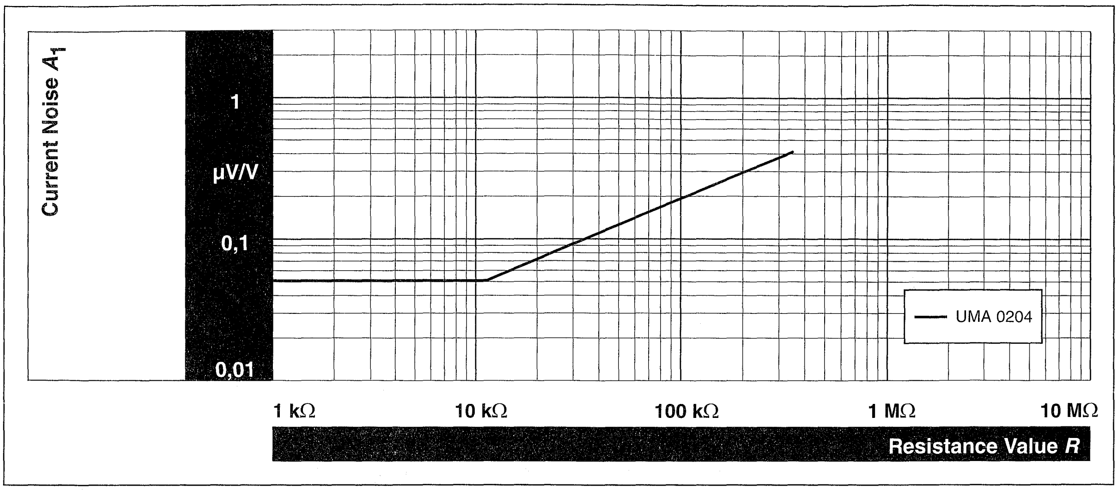
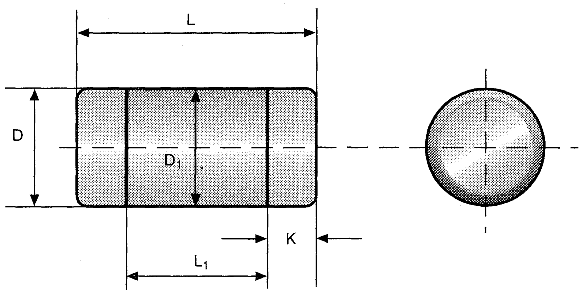


Fig.3 Current noise A_1 in accordance with IEC 60195.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.4 Outlines.

Table 4 MELF resistor type, mass and relevant physical dimensions; see Fig.4

TYPE	L (mm)	D (mm)	$L_{1\,min}$ (mm)	D_1 (mm)	K (mm)	MASS (mg)
UMA 0204	3,6 +0/−0,2	1,4 +0/−0,1	1,8	D +0/−0,15	0,8 ±0,1	19

Ultra precision MELF resistor UMA 0204

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 140400 / IEC 60115-8, Sectional specification (includes schedule for qualification approval)
- CECC 40401-803, Detail specification (includes schedule for conformance inspection)

Table 5 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 60 068-1, 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)			
				–	STABILITY CLASS 0,05	STABILITY[1] CLASS 0,1	STABILITY[1] CLASS 0,25
			stability for product types: **UMA 0204**	100 Ω to 100 kΩ	100 Ω to 100 kΩ	43 Ω to 221 kΩ	22 Ω to 221 kΩ
4.5	–	resistance	–	±0,05%; ±0,02%	±0,25%; ±0,1%		
4.8.4.2	–	temperature coefficient	at 20 / −10 / 20 °C and 20 / 85 / 20 °C	±10 ppm/K; ±05 ppm/K			
			at 20 / −55 / 20 °C and 20 / 125 / 20 °C	±15 ppm/K			
4.25.1	–	endurance; precision operation mode (P_{70} = 70 mW)	room temperature; $U = \sqrt{P_{70} \times R} \leq U_{max}$; 1,5 h on; 0,5 h off;				
			70 °C; 1000 h	±(200 ppm + 5 mΩ)	±(0,05% + 10 mΩ)	±(0,1% + 10 mΩ)	–
			70 °C; 8000 h	t.b.f.[2]	±(0,1% + 10 mΩ)	±(0,2% + 10 mΩ)	–

Ultra precision MELF resistor UMA 0204

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)			
				–	STABILITY CLASS 0,05	STABILITY(1) CLASS 0,1	STABILITY(1) CLASS 0,25
			stability for product types: UMA 0204	100 Ω to 100 kΩ	100 Ω to 100 kΩ	43 Ω to 221 kΩ	22 Ω to 221 kΩ
4.25.1 (cont.)	–	endurance; standard operation mode (P_{70} = 250 mW)	room temperature; $U = \sqrt{P_{70} \times R} \leq U_{max}$; 1,5 h on; 0,5 h off;				
			70 °C; 1000 h	±(500 ppm + 5 m Ω)	–	–	±(0,25% + 50 mΩ)
			70 °C; 8000 h	t.b.f.(2)	–	–	±(0,5% + 50 mΩ)
4.25.3	–	endurance at upper category temperature	85 °C; 1000 h	±(200 ppm + 5 m Ω)	±(0,05% + 10 mΩ)	±(0,1% + 10 mΩ)	±(0,1% + 50mΩ)
			125 °C; 1000 h	±(500 ppm + 5 mΩ)	–	–	±(0,25% + 50 mΩ)
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	t.b.f.(2)	±(0,05% + 10 mΩ)	±(0,1% + 10 mΩ)	±(0,25% + 50 mΩ)
4.23		climatic sequence:					
4.23.2	2 (Ba)	dry heat	UCT; 16 h				
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90% RH; 1 cycle				
4.23.4	1 (Aa)	cold	LCT °C; 2 h				
4.23.5	13 (M)	low air pressure	8,5 kPa; 2 h; 25 ± 10 °C				
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90% RH; 5 cycles				
			LCT = –10 °C; UCT = 85 °C	t.b.f.(2)	±(0,05% + 10 mΩ) no visible damage	±(0,1% + 10 mΩ) no visible damage	–
			LCT = –55 °C; UCT = 125 °C	–	–	–	±(0,25% + 50 mΩ) no visible damage
–	1 (Aa)	cold	–55 °C; 2 h	t.b.f.(2)	±(0,01% + 10 mΩ)	±(0,02% + 10 mΩ)	±(0,05% + 10 mΩ)

Ultra precision MELF resistor UMA 0204

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)			
				–	STABILITY CLASS 0,05	STABILITY[(1)] CLASS 0,1	STABILITY[(1)] CLASS 0,25
			stability for product types: **UMA 0204**	100 Ω to 100 kΩ	100 Ω to 100 kΩ	43 Ω to 221 kΩ	22 Ω to 221 kΩ
4.13	–	short time overload; precision operation mode (P_{70} = 70 mW)	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ $\leq 2 \times U_{max}$; 5 s	±(100 ppm + 5 m Ω) no visible damage	–	–	
		short time overload; standard operation mode (P_{70} = 250 mW)	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ $\leq 2 \times U_{max}$; 5 s	t.b.f.[(2)]	±(0,01% + 10 mΩ) no visible damage	±(0,02% + 10 mΩ) no visible damage	±(0,05% + 10 mΩ) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at −55 °C and 30 minutes at 125 °C; 5 cycles	t.b.f.[(2)]	±(0,01% + 10 mΩ) no visible damage	±(0,02% + 10 mΩ) no visible damage	±(0,05% + 10 mΩ) no visible damage
4.29	45 (XA)	component solvent resistance	isopropyl alcohol; +23 °C; toothbrush method	marking legible; no visible damage			
4.18.2	58 (Td)	resistance to soldering heat	solder bath method; 260 ±5 °C; 10 ±1 s	note 3	±(0,02% + 10 mΩ) no visible damage	±(0,02% + 10 mΩ) no visible damage	±(0,05% + 10 mΩ) no visible damage
			reflow method 2 (IR / forced convention) 235 ±3 °C; 10 ± 1 s	±(0,01% + 10 mΩ) no visible damage	–	–	–
4.17.2	58 (Td)	solderability	solder bath method; +215 °C; 3 s	good tinning (≥ 95% covered); no visible damage			
4.32	21 (Ue_3)	shear (adhesion)	5 N; 10 s	no visible damage			
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown			

Notes

1. Products with tolerance ±0,25% and ±0,1% are subject to improvement, aiming at ±0,05% requirements.
2. Actual requirements were not available before going to press.
3. Wave soldering is not recommended.

High pulse load MELF resistor CMA 0204

FEATURES

- Speciality product for EMC sensitive applications
- Special carbon film technology for maximum heat stress capability
- Up to 4 kV or 70 W pulse load capability
- Resistance range: 10 Ω to 100 kΩ
- Metric sizes:
  - DIN: 0204
  - CECC: RC 3715M

APPLICATIONS

- Automotive
- Telecommunication
- Industrial equipment.

DESCRIPTION

CMA 0204 speciality MELF 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. The applications are in all fields of automotive, telecommunication and industrial equipment.

Production of the **CMA 0204 speciality MELF resistors** with advanced pulse load capability 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% Al_2O_3). Nickel plated steel termination caps are firmly pressed on the coated 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. 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 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 laid directly into the blister tape in accordance with **IEC 60 286-3**.

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

Where applicable, the resistors are tested in accordance with **CECC 40 401-803** which refers to **EN 140 000** (**IEC 60 115-1**) and **EN 140 400 (IEC 60 115-8).**

BCcomponents BEYSCHLAG has achieved **"Approval of Manufacturer"** in accordance with **EN 100 114-1**.

High pulse load MELF resistor CMA 0204

QUICK REFERENCE DATA

DESCRIPTION	CMA 0204	
Metric CECC size	RC 3715M	
Resistance range	10 Ω to 100 kΩ	
Resistance tolerance	±2%	
Temperature coefficient	see Fig.8	
Operation mode	standard	power
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	200 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	
1 000 h	±1%	±2%
8000 h	+3% / −1%	+5% / −2%
Specified lifetime	8 000 h	
Permissible voltage against ambient:		
1 minute	300 V	
continuous	75 V	
Failure rate	$\leq 1 \times 10^{-9}$/h	

Table 1 Tolerance and resistance range

TOLERANCE	RESISTANCE VALUE[1]
	CMA 0204
±2%	10 Ω to 100 kΩ

Note

1. Resistance value to be selected from E24 series.

High pulse load MELF resistor CMA 0204

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION		ORDERING CODE 2312	
		BLISTER TAPE ON REEL	
TYPE	TOL.	BL 3000 units	B0 10000 units
CMA 0204	±2%	**159 2....**	149 2....

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

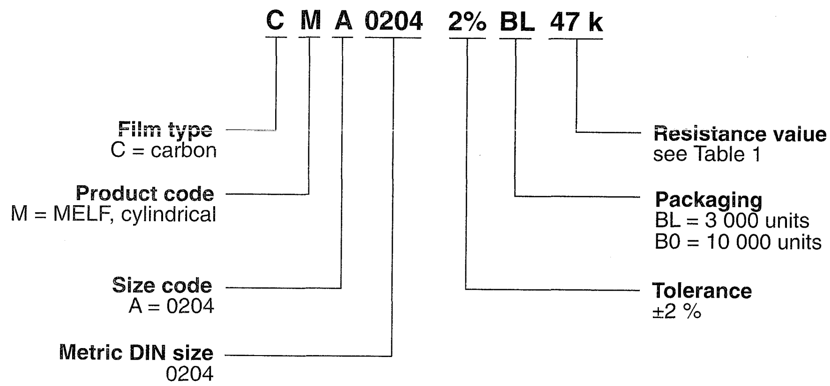
RESISTANCE DECADE	LAST DIGIT
10 Ω to 99,9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9,99 kΩ	2
10 kΩ to 99,9 kΩ	3
100 kΩ to 999 kΩ	4

ORDERING EXAMPLE

The ordering code of a CMA 0204 resistor, value 47 kΩ with ±2% tolerance, supplied in blister tape of 3 000 units per reel is: 2312 159 24703.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



For CMA 0204 the temperature coefficient is not identified in the ordering code.

High pulse load MELF resistor CMA 0204

FUNCTIONAL DESCRIPTION

Derating

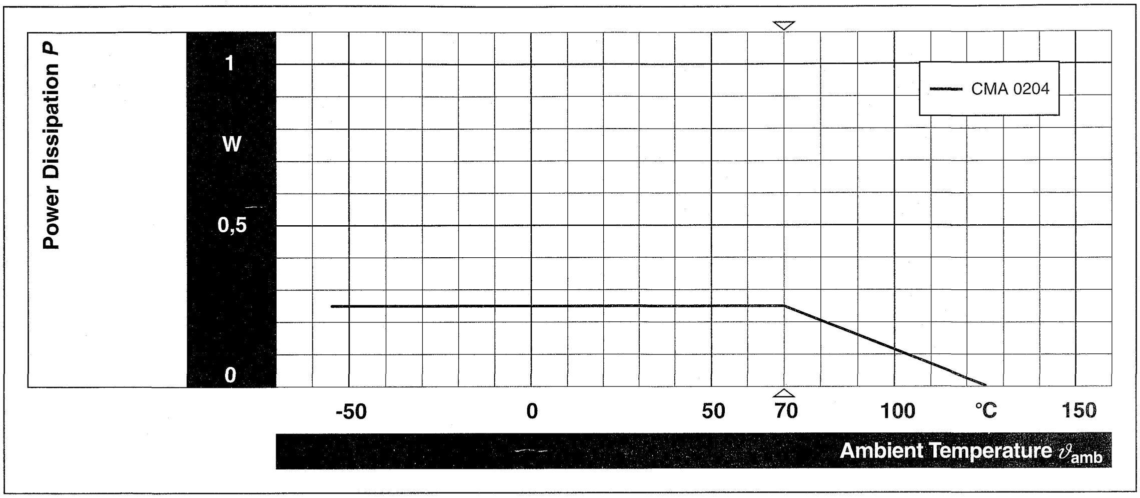


Fig.1 Derating, standard operation.

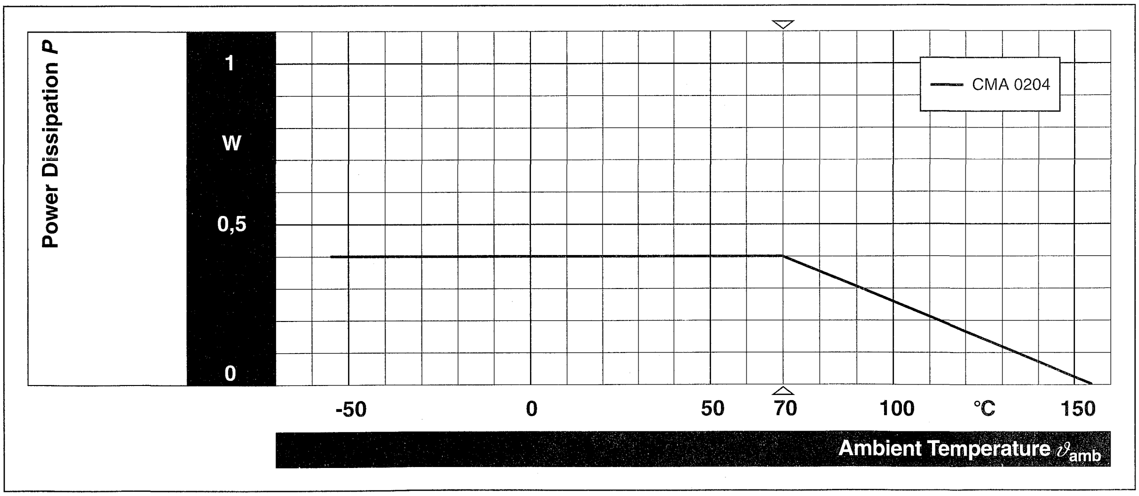


Fig.2 Derating, power operation.

Single pulse

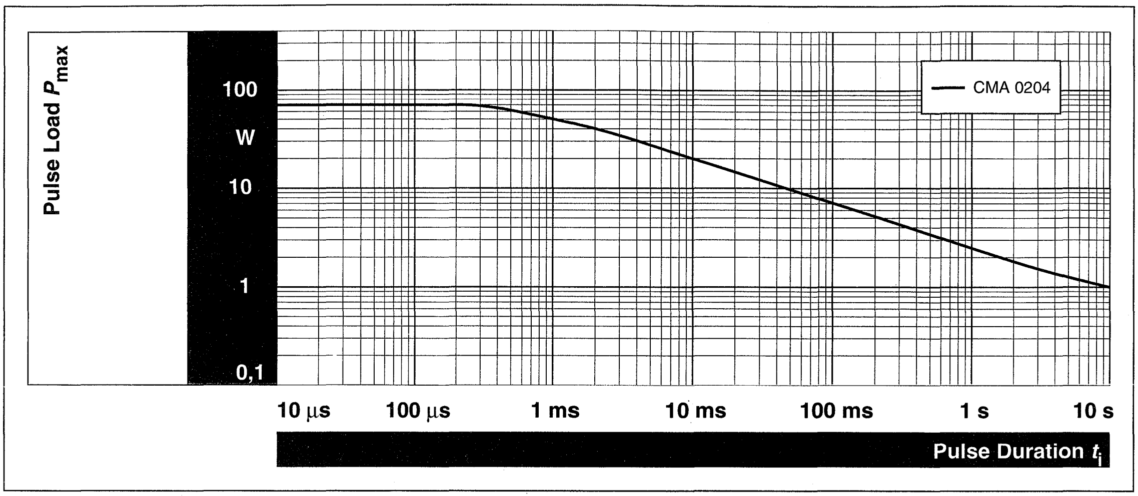


Fig.3 Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation.

Continuous pulses

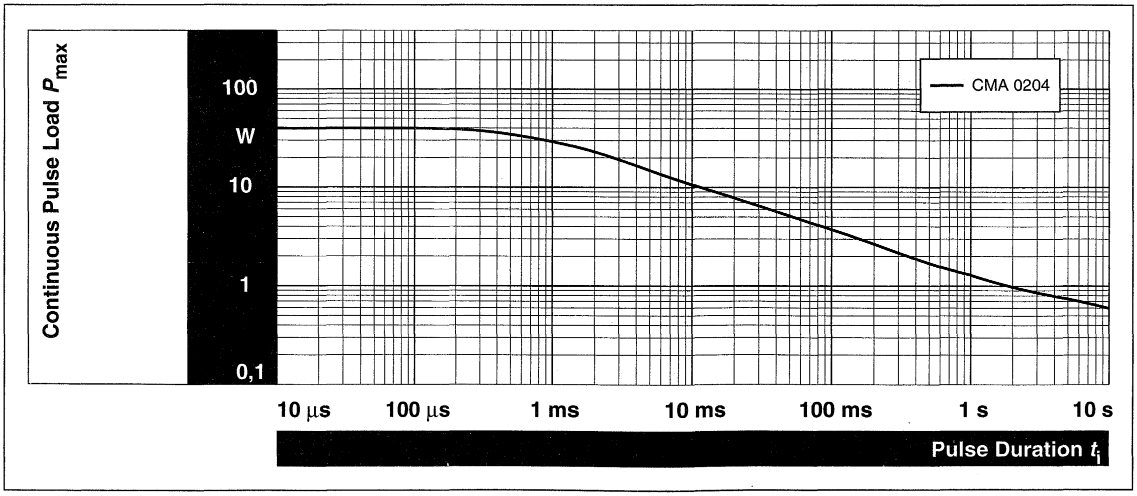


Fig.4 Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Pulse voltage

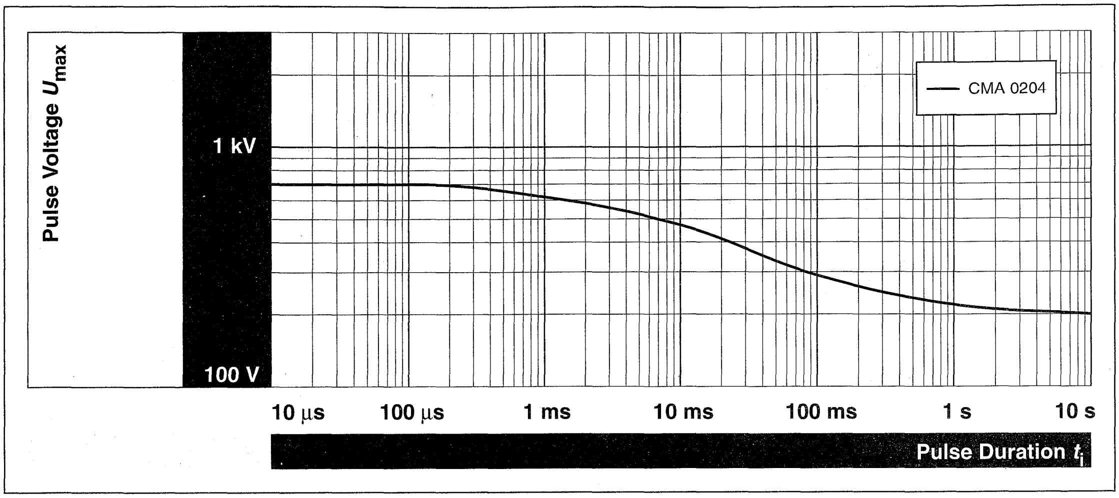


Fig.5 Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation.

High pulse load MELF resistor CMA 0204

1,2/50 pulse

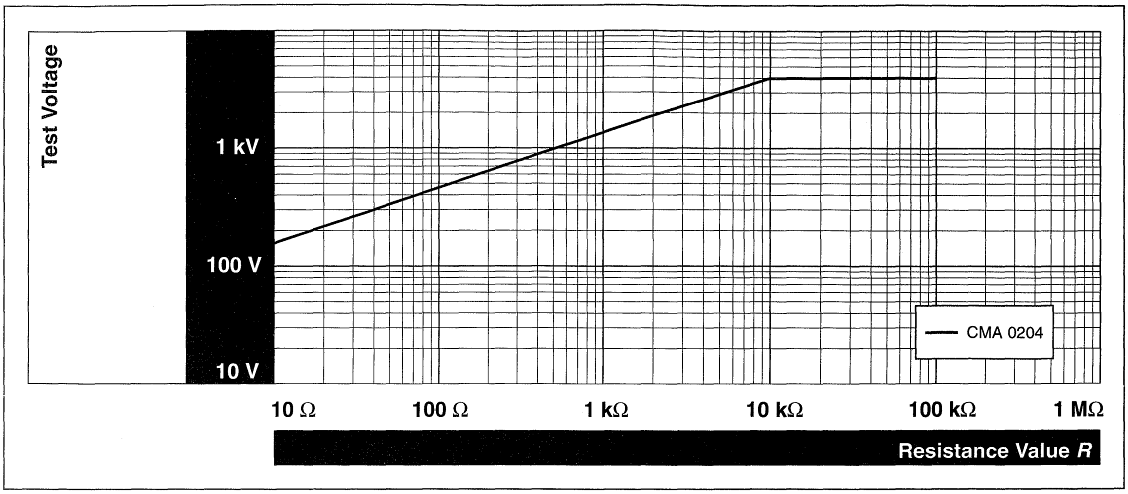


Fig.6 Pulse load rating in accordance with IEC 60115-1, 4.27; 1,2 µs / 50 µs; 5 pulses at 12 s intervals; for permissible resistance change 0,5%.

10/700 pulse

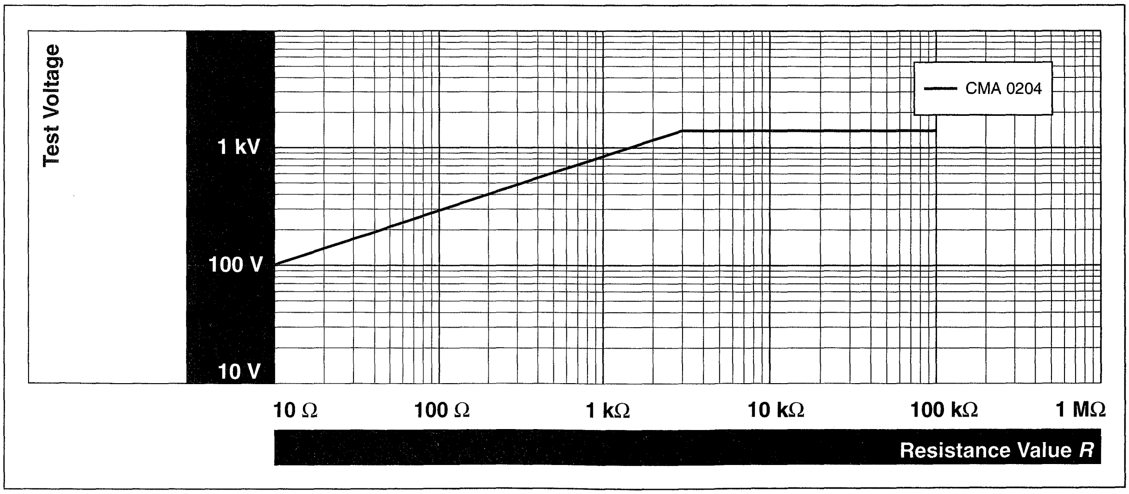


Fig.7 Pulse load rating in accordance with IEC 60115-1, 4.27; 10 µs / 700 µs; 10 pulses at 1minute intervals; for permissible resistance change 0,5%.

Temperature coefficient (T.C.)

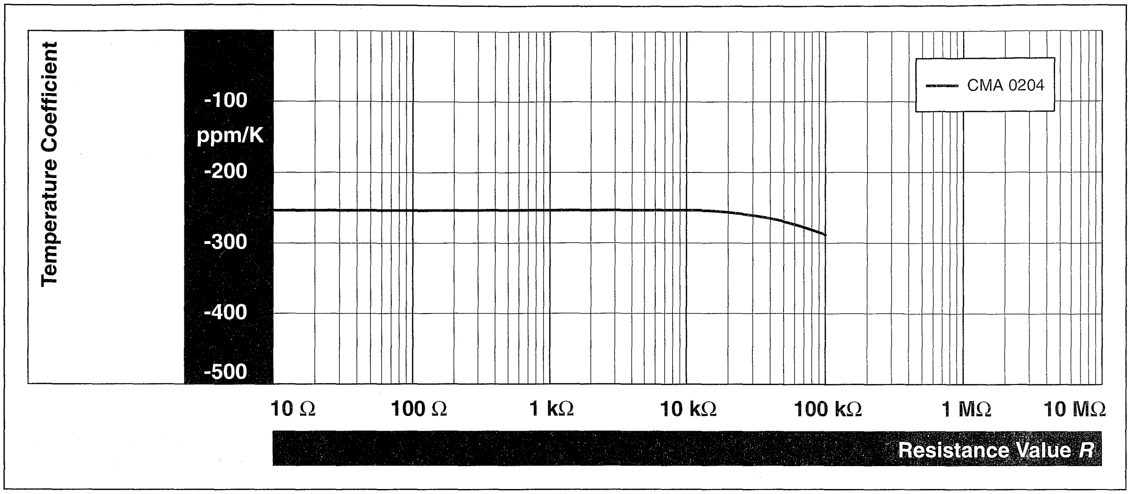


Fig.8 Temperature coefficient of resistance.

Current noise

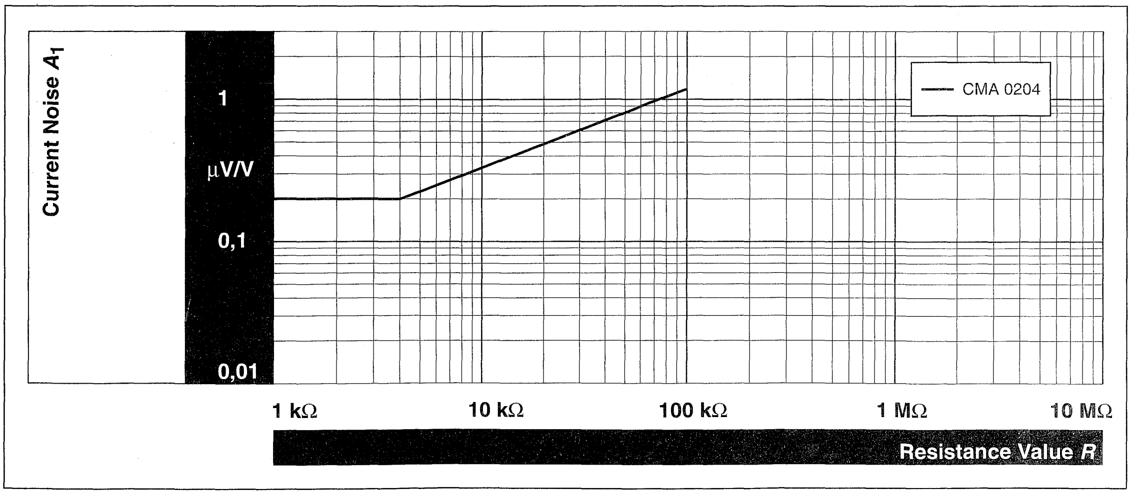
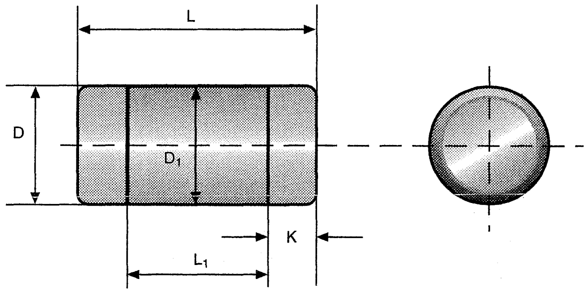


Fig.9 Current Noise A_1 in accordance with IEC 60195.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.10 Outlines.

Table 4 MELF resistor types, mass and relevant physical dimensions; see Fig.10

TYPE	L (mm)	D (mm)	$L_{1\ min}$ (mm)	D_1 (mm)	K (mm)	MASS (mg)
CMA0204	3,6 +0/–0,2	1,4 +0/–0,1	1.8	D +0/–0,1	0,8 ±0,1	19

High pulse load MELF resistor CMA 0204

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 140400 / IEC 60115-8, Sectional specification (includes schedule for qualification approval)
- CECC 40401-803, Detail specification (includes schedule for conformance inspection)

Table 5 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 Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types: CMA 0204	10 Ω to 100 kΩ
4.5	–	resistance	–	±2%
4.8.4.2	–	temperature coefficient	at 20 / −55 / 20 °C and 20 / 125 / 20 °C	see Fig.8
4.25.1	–	endurance; standard operation mode	room temperature; $U = \sqrt{P_{70} \times R} \leq U_{max}$; 1,5 h on; 0,5 h off; 70 °C; 1000 h 70 °C; 8000 h	 ±(2% + 0,05 Ω) ±(4% + 0,05 Ω)
4.25.1	–	endurance; power operation mode	room temperature; $U = \sqrt{P_{70} \times R} \leq U_{max}$; 1,5 h on; 0,5 h off; 70 °C; 1000 h 70 °C; 8000 h	 t.b.f.(1) t.b.f.(1)
4.25.3	–	endurance at upper category temperature	125 °C; 1000 h 155 °C; 1000 h	±(4% + 0,1 Ω) t.b.f.(1)
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/−3% RH	±(1% + 0,1 Ω)

High pulse load MELF resistor CMA 0204

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types: CMA 0204	10 Ω to 100 kΩ
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	UCT; 16 h	
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90% RH; 1 cycle	
4.23.4	1 (Aa)	cold	LCT; 2 h	
4.23.5	13 (M)	low air pressure	8,5 kPa; 2 h; 25 ± 10 °C	
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90% RH; 5 cycles LCT = −55 °C; UCT = 155 °C	±(1% + 0,1 Ω) no visible damage
–	1 (Aa)	cold	−55 °C; 2 h	±(0,5 % + 0,1 Ω)
4.13	–	short time overload; standard operation mode	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±(0,25% + 0,1 Ω) no visible damage
		short time overload; power operation mode	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±(0,25% + 0,1 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at −55 °C; 30 minutes at +125°C; 5 cycles	±(0,5% + 0,1 Ω) no visible damage
4.29	45 (XA)	component solvent resistance	isopropyl alcohol; +23 °C; toothbrush method	marking legible; no visible damage
4.18.2	58 (Td)	resistance to soldering heat	unmounted components; 260 ± 5 °C; 10 ± 1 s	±(0,5% + 0,1 Ω) no visible damage
4.17.2	58 (Td)	solderability	solder bath method; +215 °C; 3 s	good tinning (≥ 95% covered); no visible damage
4.32	21 (Ue_3)	shear (adhesion)	5 N; 10 s	no visible damage
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown

Note

1. Actual requirements were not available before going to press.

High frequency MELF resistors

MMU 0102 HF; MMA 0204 HF; MMB 0207 HF

FEATURES

- Speciality product for RF applications
- Low-inductance non-helical trimmed product
- Suitable for more than 10 GHz
- Resistance range: 1,5 Ω to 475 Ω
- Metric sizes:
  - DIN: 0102; 0204; 0207
  - CECC: RC 2211M; RC 3715M; RC 6123M

APPLICATIONS

- Telecommunication equipment
- Industrial electronics.

DESCRIPTION

MMU 0102 HF, MMA 0204 HF and MMB 0207 HF speciality thin film MELF 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. In special situations where MMU 0102 HF, MMA 0204 HF or MMB 0207 HF resistors were mounted to a solid ground plane or module case, the rated power dissipation could have been exceeded by far.

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 (85% Al_2O_3, for MICRO-MELF: 96% Al_2O_3) ceramic body 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 non helical groove with a resulting low inductivity in the resistive layer without damaging the ceramics. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection.The terminations receive a final pure tin on nickel plating. Four or five 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 laid directly into the blister tape in accordance with **IEC 60286-3** or bulk case in accordance with **IEC 60286-6**.

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

Where applicable, the resistors are tested in accordance with **CECC 40 401-803** which refers to **EN 140 000** (**IEC 60 115-1**) and **EN 140 400 (IEC 60 115-8)**.

BCcomponents BEYSCHLAG has achieved **"Approval of Manufacturer"** in accordance with **EN 100 114-1**.

High frequency MELF resistors

MMU 0102 HF; MMA 0204 HF; MMB 0207 HF

QUICK REFERENCE DATA

DESCRIPTION	MMU 0102 HF		MMA 0204 HF		MMB 0207 HF	
Metric CECC size	RC 2211M		RC 3715M		RC 6123M	
Resistance range	6,8 Ω to 470 Ω		1,5 Ω to 475 Ω		6,8 Ω to 470 Ω	
Resistance tolerance	±2%		±1%		±2%	
Temperature coefficient	±50 ppm/K					
Operation mode	standard	power	standard	power	standard	power
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}	0,2 W	0,3 W	0,25 W	0,4 W	0,4 W	1,0 W[(1)]
Operating voltage, U_{max} AC/DC	limited by P_{70}		limited by P_{70}		limited by P_{70}	
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:	6,8 Ω to 470 Ω		1,5 Ω to 475 Ω		6,8 Ω to 470 Ω	
1 000 h	≤ 0,25%	≤ 0,5%	≤ 0,25%	≤ 0,5%	≤ 0,25%	≤ 0,5%
8000 h	≤ 0,5%	≤ 1,0%	≤ 0,5%	≤ 1,0%	≤ 0,5%	≤ 1,0%
225000 h	≤ 1,5%	–	≤ 1,5%	–	≤ 1,5%	–
Specified lifetime	225000 h	8000 h	225000 h	8000 h	225000 h	8000 h
Permissible voltage against ambient :						
1 minute	150 V		300 V		500 V	
continuous	75 V		75 V		75 V	
Failure rate	$\leq 2,0 \times 10^{-9}$/h		$\leq 0,7 \times 10^{-9}$/h		$\leq 0,7 \times 10^{-9}$/h	

Note

1. Specified power rating requires dedicated heat-sink pads.

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[(1)]		
T.C.	TOLERANCE	MMU 0102 HF	MMA 0204 HF	MMB 0207 HF
±50 ppm/K	±2%	6,8 Ω to 470 Ω; 50 Ω	–	6,8 Ω to 470 Ω; 50 Ω
	±1%	–	1,5 Ω to 475 Ω; 50 Ω	–

Note

1. Resistance value to be selected from E24 series for ±2% tolerance and from E96 series for ±1% tolerance.

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312						
			BLISTER TAPE ON REEL					BULK CASE	
TYPE	T.C.	TOL.	B1 1000 units	B2 2000 units	BL 3000 units	B7 7000 units	B0 10000 units	M3 3000 units	M8 8000 units
MMU 0102 HF	±50 ppm/K	±2%	173 0....	–	**168 0....**	–	178 0....	–	063 0
MMA 0204 HF	±50 ppm/K	±1%	143 0....	–	**158 0....**	–	148 0....	043 0....	–
MMB 0207 HF	±50 ppm/K	±2%	183 0....	**198 0....**	–	188 0....	–	–	–

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

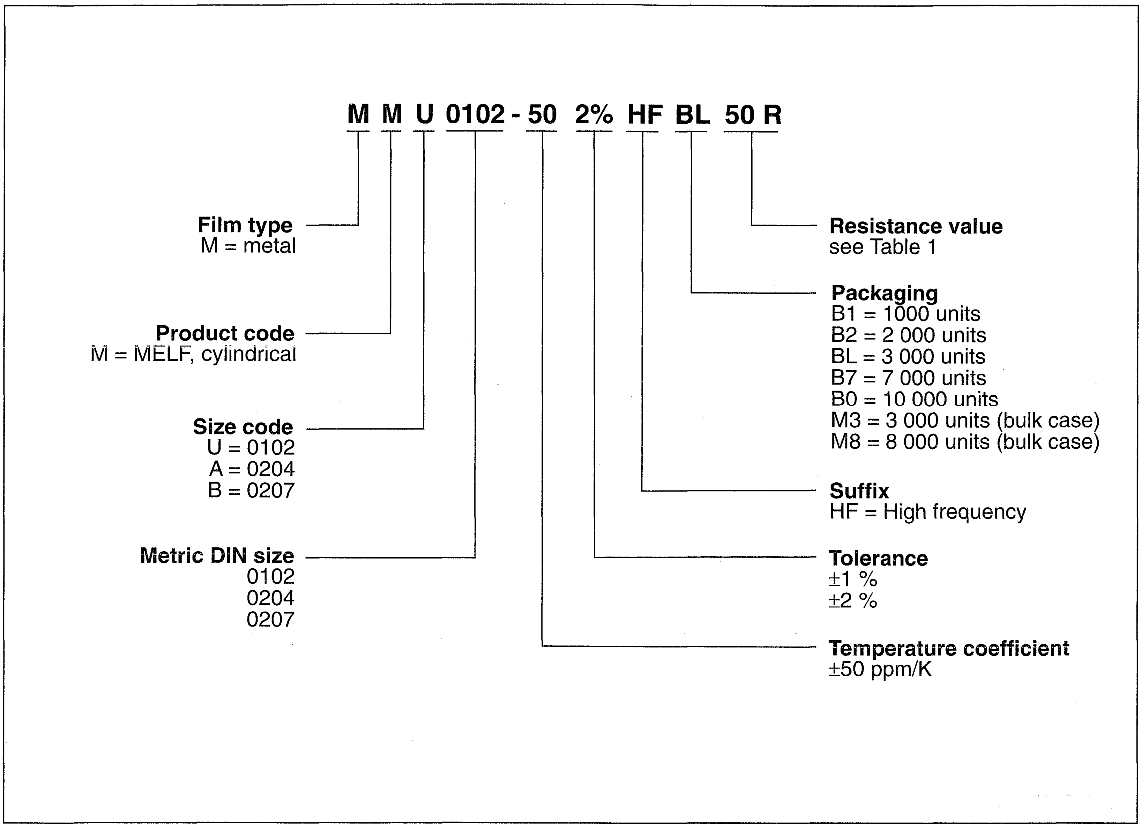
RESISTANCE DECADE	LAST DIGIT
1 Ω to 9,99 Ω	8
10 Ω to 99,9 Ω	9
100 Ω to 999 Ω	1

ORDERING EXAMPLE

The ordering code of a MMU 0102 HF resistor, value 50 Ω and TC 50 with ±2% tolerance, supplied in blister tape of 3000 units per reel is: 2312 168 0500 9.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



FUNCTIONAL DESCRIPTION

Derating

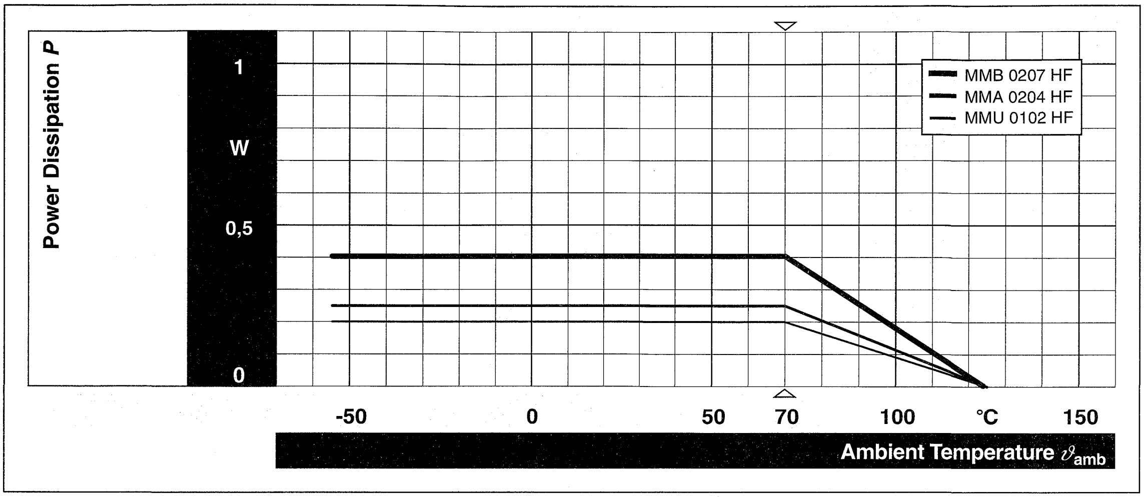


Fig.1 Derating, standard operation.

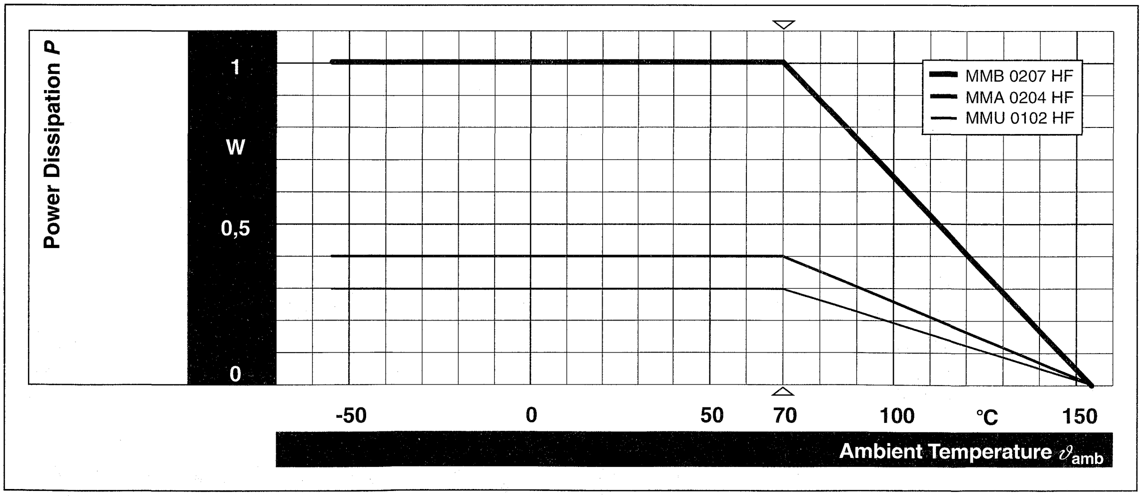


Fig.2 Derating, power operation.

RF-behaviour

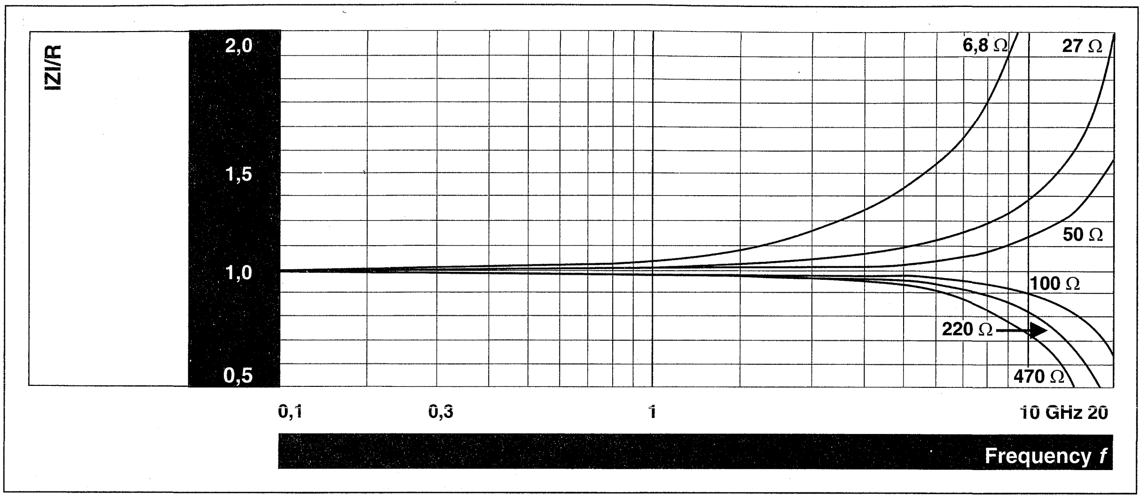


Fig.3 IZI/R for MMU 0102 HF.

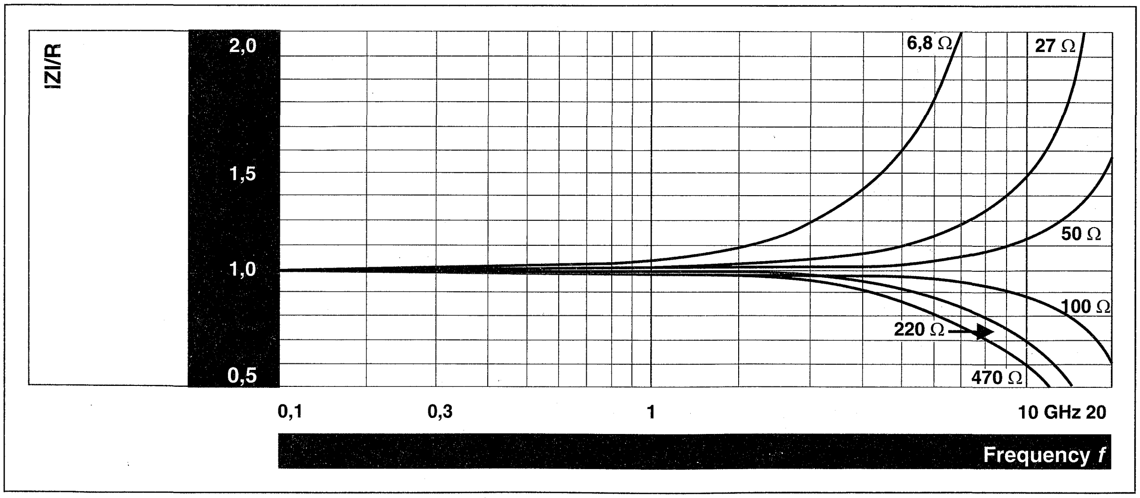


Fig.4 IZI/R for MMA 0204 HF.

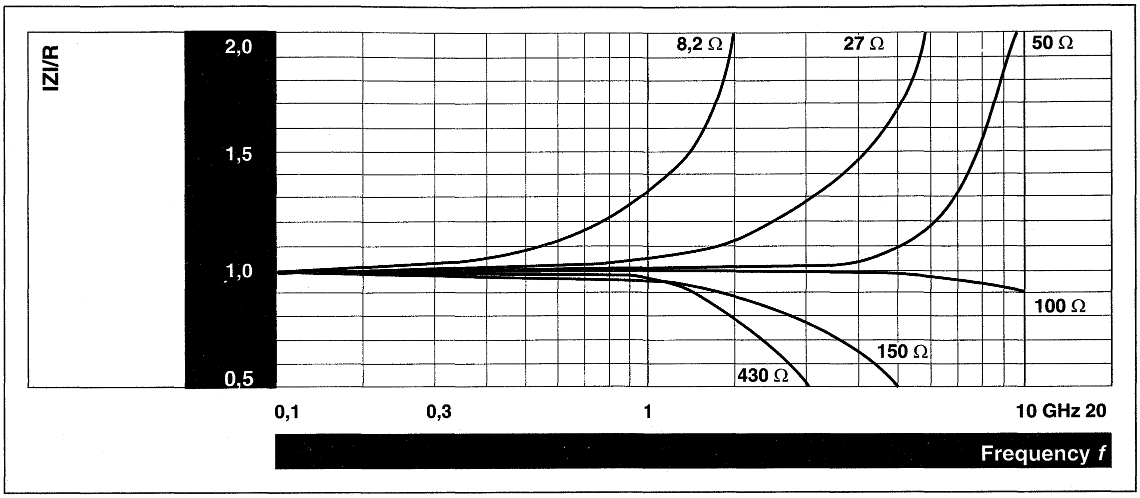
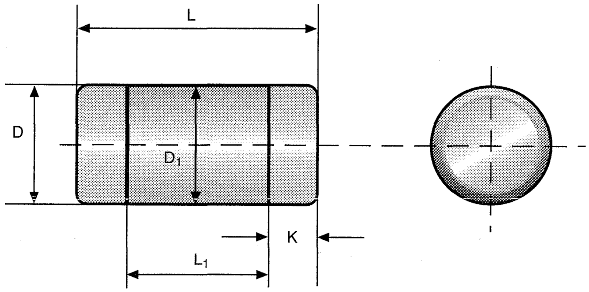


Fig.5 IZI/R for MMB 0207 HF.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.6 Outlines.

Table 4 MELF resistor types, mass and relevant physical dimensions; see Fig.6

TYPE	L (mm)	D (mm)	$L_{1\,min}$ (mm)	D_1 (mm)	K (mm)	MASS (mg)
MMU 0102 HF	2,2 +0/–0,1	1,1 +0/–0,1	1,2	D +0/–0,04	0,4 ±0,05	7
MMA 0204 HF	3,6 +0/–0,2	1,4 +0/–0,1	1,8	D +0/–0,15	0,8 ±0,1	19
MMB 0207 HF	5,8 +0/–0,2	2,2 +0/–0,2	2,8	D +0/–0,2	1,2 ±0,2	78

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 140400 / IEC 60115-8, Sectional specification (includes schedule for qualification approval)

CECC 40401-803, Detail specification (includes schedule for conformance inspection)

Table 5 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types:	
			MMU 0102 HF	6,8 Ω to 470 Ω
			MMA 0204 HF	1,5 Ω to 475 Ω
			MMB 0207 HF	6,8 Ω to 470 Ω
4.5	–	resistance	–	MMU 0102 HF, MMB 0207 HF: ±2% MMA 0204 HF: ±1%
4.8.4.2	–	temperature coefficient	at 20 / −55 / 20 °C and 20 / 125 / 20 °C	±50 ppm/K
4.25.1	–	endurance; standard operation mode	room temperature; $U = \sqrt{P_{70} \times R} \leq U_{max}$; 1,5 h on; 0,5 h off;	
			70 °C; 1 000 h	±(0,25% + 50 mΩ)
			70 °C; 8000 h	±(0,5% + 50 mΩ)
		endurance; power operation mode	room temperature; $U = \sqrt{P_{70} \times R} \leq U_{max}$; 1,5 h on; 0,5 h off;	
			70 °C; 1 000 h	±(0,5% + 50 mΩ)
			70 °C; 8000 h	±(1% + 50 mΩ)
4.25.3	–	endurance at upper category temperature	125 °C; 1 000 h	±(0,5% + 50 mΩ)
			155 °C; 1 000 h	±(1% + 50 mΩ)

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types:	
			MMU 0102 HF	6,8 Ω to 470 Ω
			MMA 0204 HF	1,5 Ω to 475 Ω
			MMB 0207 HF	6,8 Ω to 470 Ω
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/−3% RH	±(0,5% + 50 mΩ)
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	UCT; 16 h	
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90% RH; 1 cycle	
4.23.4	1 (Aa)	cold	LCT; 2 h	
4.23.5	13 (M)	low air pressure	8,5 kPa; 2 h; 25 ± 10 °C	
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90% RH; 5 cycles	
			LCT = −55 °C; UCT = 155 °C	±(0,5% + 50 mΩ) no visible damage
−	1 (Aa)	cold	−55 °C; 2 h	±(0,1% + 10 mΩ)
4.13	−	short time overload; standard operation mode	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±(0,1% + 10 mΩ) no visible damage
		short time overload; power operation mode	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±(0,1% + 10 mΩ) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at −55 °C; 30 minutes at 155°C; 5 cycles	±(0,25% + 50 mΩ) no visible damage
4.29	45 (XA)	component solvent resistance	isopropyl alcohol; +23 °C; toothbrush method	marking legible; no visible damage

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types:	
			MMU 0102 HF	6,8 Ω to 470 Ω
			MMA 0204 HF	1,5 Ω to 475 Ω
			MMB 0207 HF	6,8 Ω to 470 Ω
4.18.2	58 (Td)	resistance to soldering heat	solder bath method; 260 ± 5 °C; 10 ± 1 s	±(0,5% + 50 mΩ) no visible damage
4.17.2	58 (Td)	solderability	solder bath method; 215 °C; 3 s	good tinning (≥ 95% covered); no visible damage
4.32	21 (Ue_3)	shear (adhesion)	5 N; 10 s	no visible damage
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown

Linear leaded resistors

Selection guide

APPLICATION	TYPE	TOLERANCE (%)	RESISTANCE RANGE	DISSIPATION at °C	DISSIPATION W	PAGE
Metal film						
Standard	SFR16S	±5	1 Ω to 3 MΩ	70	0.50	152
	SFR25		0.22 Ω to 10 MΩ		0.40	
	SFR25H				0.50	
Professional	MBA 0204	±0.5; ±1; ±5	0.22 Ω to 10 MΩ	70	0.4	165
	MBB 0207		0.22 Ω to 22 MΩ		0.6	
	MBE 0414		0.22 Ω to 22 MΩ		1.0	
Precision	MBA 0204	±0.1; ±0.25	22 Ω to 332 kΩ	70	0.25	178
	MBB 0207		10 Ω to 1 MΩ		0.4	
	MBE 0414		22 Ω to 1.5 MΩ		0.65	
Ultra Precision	UXA 0204	±0.25; ±0.1; ±0.05; ±0.01	22 Ω to 221 kΩ	85	0.05	189
	UXB 0207		10 Ω to 1 MΩ		0.125	
	UXC 0309		10 Ω to 1 MΩ		0.25	
Ultra Precision	MPR24	±0.5; ±0.25; ±0.1	4.99 Ω to 1 MΩ	70	0.25	201
		±0.05; ±0.02; ±0.01	24 Ω to 100 kΩ		0.125	
Application specific						
Fusible	NFR25	±5	0.22 Ω to 15 kΩ	70	0.33	209
	NFR25H				0.50	
High ohmic/high voltage	VR25	±1; ±5; ±10	100 kΩ to 22 MΩ	70	0.25	219
	VR37	±1; ±5	100 kΩ to 33 MΩ		0.50	225
	VR68		100 kΩ to 68 MΩ		1.0	231
Low ohmic surge	LSR37	±10; ±20	220 Ω to 10 kΩ	70	0.5	237
High pulse load	CBB 0207	±2	10 Ω to 1.5 MΩ	70	0.6	244
High frequency	MBA 0204 HF	±2	1.5 Ω to 470 Ω	70	0.4	256
Power						
Metal film power	PR01	±1; ±5	0.22 Ω to 1 Ω	70	0.6	266
			1 Ω to 1 MΩ		1	
	PR02		0.33 Ω to 1 Ω		1.2	
			1 Ω to 1 MΩ		2	
	PR03		0.68 Ω to 1 Ω		1.6	
			1 Ω to 1 MΩ		3	

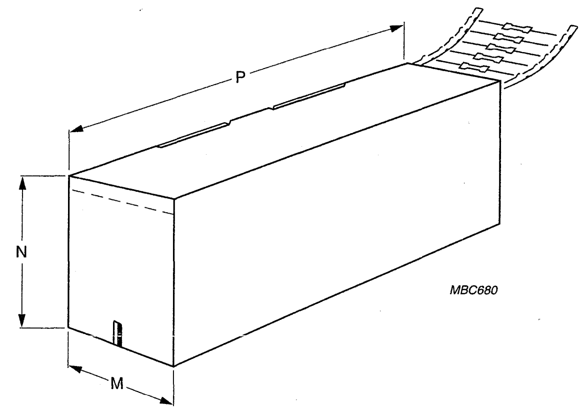
Linear leaded resistors

Selection guide

APPLICATION	TYPE	TOLERANCE (%)	RESISTANCE RANGE	DISSIPATION at °C	DISSIPATION W	PAGE
Cemented wirewound	AC01	±5	0.1 Ω to 2 kΩ	40	1	289
	AC03		0.1 Ω to 4.7 kΩ		3	
	AC04		0.1 Ω to 6.8 kΩ		4	
	AC05		0.1 Ω to 8.2 kΩ		5	
	AC07		0.1 Ω to 15 kΩ		7	
	AC10		0.68 Ω to 27 kΩ		10	
	AC15		0.82 Ω to 39 kΩ		15	
	AC20		1.2 Ω to 56 kΩ		20	
Miniature power	SMW02; SMF02	±5	0.1 Ω to 47 kΩ	70	2	312
	SMW03; SMF03				3	
	SMW05; SMF05				5	
Power	RMW03; RMF03	±5; ±10	0.22 Ω to 39 kΩ	70	3	318
	RMW05; RMF05		0.47 Ω to 51 kΩ		5	
	RMW07; RMF07		0.68 Ω to 100 kΩ		7	
	RMW10; RMF10		1 Ω to 150 kΩ		10	
Power precision	PAC01	±1	0.22 Ω to 2.2 kΩ	25	1	325
	PAC02		0.1 Ω to 3.6 kΩ		2	
	PAC03		0.1 Ω to 4.7 kΩ		3	
	PAC04		0.1 Ω to 8.2 kΩ		4	
	PAC05		0.68 Ω to 10 kΩ		5	
	PAC06		0.68 Ω to 12 kΩ		6	
Application specific power						
Low ohmic values	LVR05	±5	0.01 Ω to 0.10 Ω	40	5	331
Maintenance types (not for new designs)						
Metal film	MRS16	±1	4.99 Ω to 1 MΩ	70	0.4	340
	MRS25		1 Ω to 10 MΩ		0.6	

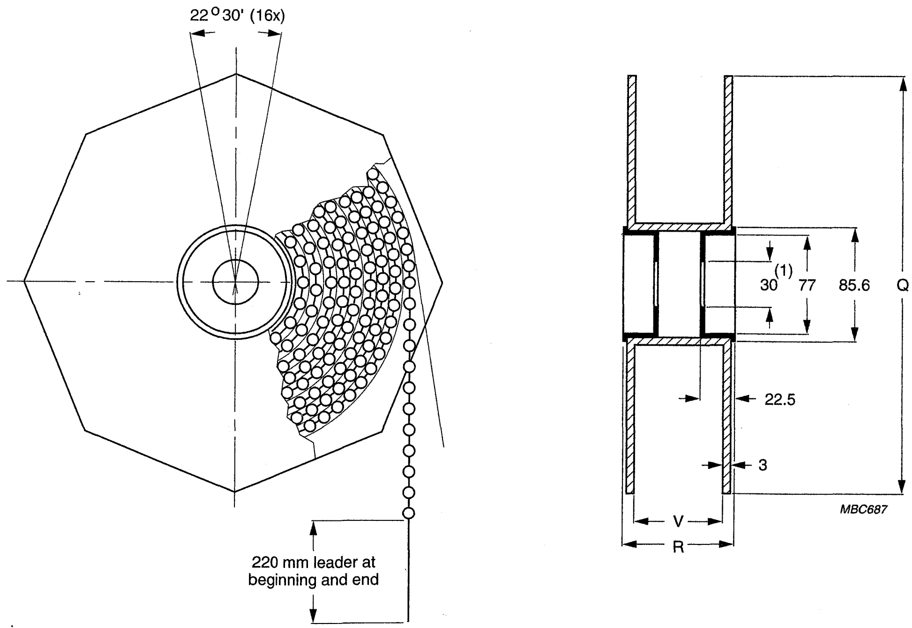
PACKAGING

Dimensions of ammopack and reel



For dimensions see Table 3.

Fig.1 Bandolier in ammopack.



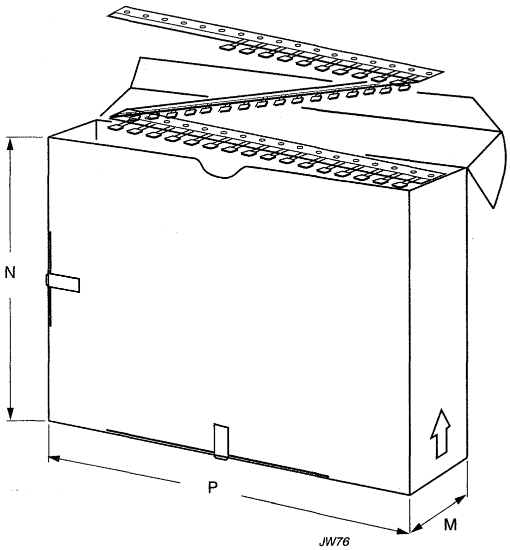
Dimensions in mm.

For dimensions see Table 4.

(1) 26 mm for UXB 0207.

Fig.2 Bandolier on reel.

Dimensions of ammopack (radial taped)



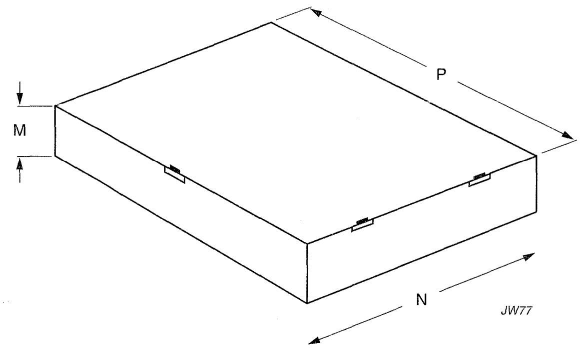
Dimensions in mm.
For dimensions see Table 1.

Fig.3 Dimensions of ammopack (radial taped).

Table 1 Resistor type, quantities and dimensions of the packaging for radial taped in **ammopack**; see Fig.3

PRODUCT TYPE	QUANTITY	PACKAGING DIMENSIONS		
		AMMOPACK		
		M (mm)	N (mm)	P (mm)
SFR25	4000	45	262	330
NFR25	4000	45	262	330
NFR25H	4000	45	262	330
PR01	4000	45	262	330
PR02	3000	45	262	330
AC01	2500	45	262	330

Dimensions of box (products with cropped or formed leads)



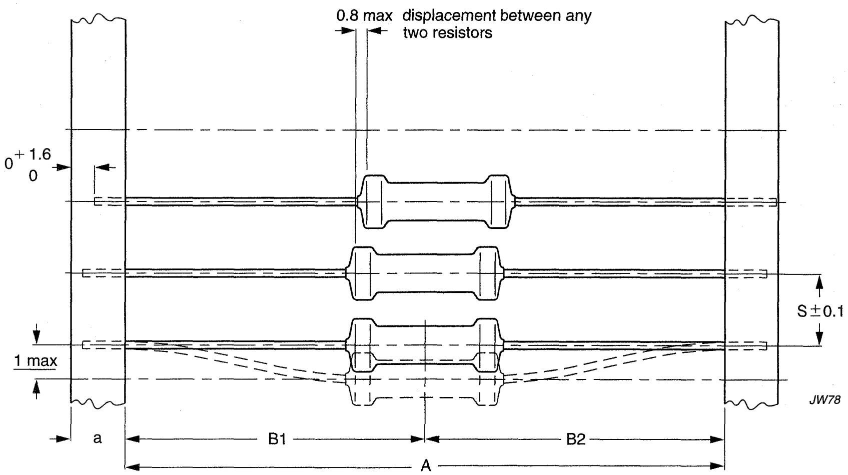
Dimensions in mm.
For dimensions see Table 2.

Fig.4 Dimensions of box.

Table 2 Resistor type, quantities and dimensions of the packaging for cropped and formed, **loose in box**; see Fig.4

PRODUCT TYPE	QUANTITY	PACKAGING DIMENSIONS LOOSE IN BOX		
		M (mm)	N (mm)	P (mm)
PR01	1000	105	70	205
PR02	500 or 1000	105	70	205
PR03	250 or 500	105	70	205

Products with straight leads



Dimensions in mm.
Maximum 1 mm per 10 spacings.
Maximum 0.5 mm per 5 spacings.
For dimensions see Tables 3 and 4.

Fig.5 Axial style on tape.

Table 3 Resistor type, quantities and packaging dimensions for axial taped in **ammopack**; see Figs 1 and 5

PRODUCT TYPE	QUANTITY	PACKAGING DIMENSIONS						
		AXIAL TAPED ON BANDOLIER				AMMOPACK		
		a (mm)	A (mm)	$\|B_1 - B_2\|$ (mm)	S (mm)	M (mm)	N (mm)	P (mm)
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 0204	1000	6 ±0.5	53 ±2.0	±1.2	5 ±0.5	75	30	187
	5000	6 ±0.5	53 ±2.0	±1.2	5 ±0.5	75	55	330
MBB 0207	1000	6 ±0.5	53 ±2.0	±1.2	5 ±0.5	75	40	187
	5000	6 ±0.5	53 ±2.0	±1.2	5 ±0.5	75	85	330
MBE 0414	1000	6 ±0.5	63 ±2.0	±1.2	5 ±0.5	45	88	378

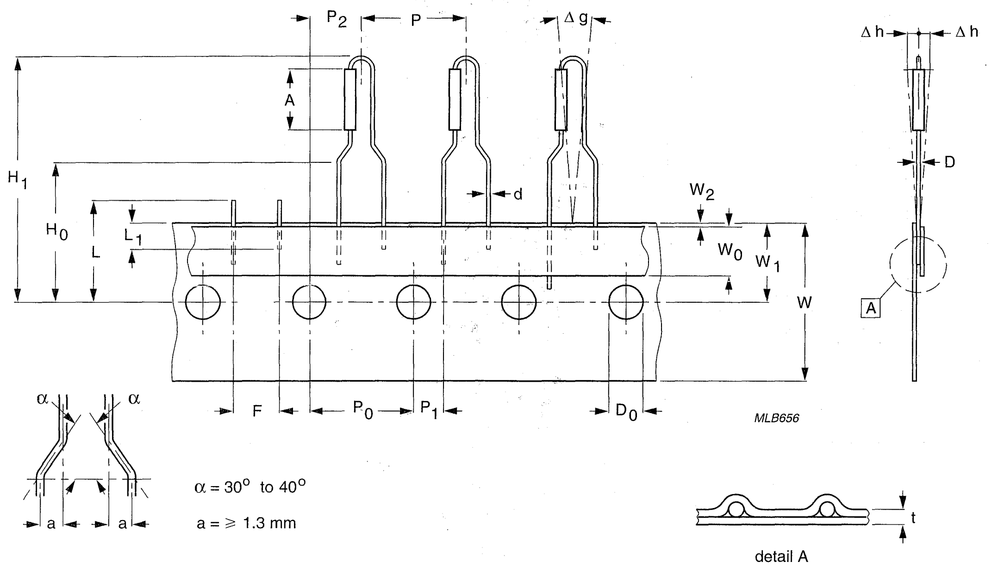
PRODUCT TYPE	QUANTITY	PACKAGING DIMENSIONS						
		AXIAL TAPED ON BANDOLIER				AMMOPACK		
		a (mm)	A (mm)	$\lvert B_1 - B_2 \rvert$ (mm)	S (mm)	M (mm)	N (mm)	P (mm)
UXA 0204	1000	6 ±0.5	53 ±2.0	5 ±0.5	5	75	30	187
UXB 0207	1000	6 ±0.5	53 ±2.0	5 ±0.5	5	75	40	187
UXC 0309	1000	6 ±0.5	65 ±2.0	5 ±0.5	5	75	45	378
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	±1.0	5	82	28	262
	2000	6 ±0.5	26 +1.5/–0	±1.0	5	50	50	255
	5000	6 ±0.5	52 +1.5/–0	±1.2	5	78	98	270
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 ±0.5	75	40	187
	5000	6 ±0.5	53 ±2.0	±1.2	5 ±0.5	75	85	330
MBA 0204 HF	1000	6 ±0.5	53 ±2.0	±1.2	5 ±0.5	75	30	187
	5000	6 ±0.5	53 ±2.0	±1.2	5 ±0.5	75	55	330
PR01	1000	6 ±0.5	53 ±2.0	±1.2	5	97	28	262
PR01	5000	6 ±0.5	52 +1.5/–0	±1.2	5	78	98	270
PR02	1000	6 ±0.5	73 ±1.5	±1.2	5	97	59	262
PR02	1000	6 ±0.5	52 +1.5/–0	±1.2	5	76	60	262
PR03	500	6 ±0.5	80 ±1.5	±1.2	10	99	77	259
PR03	500	6 ±0.5	63 ±1.5	±1.2	5	85	77	259
AC01	1000	6 ±0.5	63 ±4	±1.2	10	85	60	263
AC03	500	6 ±0.5	63 ±4	±1.2	10	85	77	259
AC04	500	6 ±0.5	63 ±4	±1.2	10	85	77	259
AC05	500	5 ±0.5	63 ±4	±1.2	10	85	112	259
AC07	500	5 ±0.5	74 ±4	±1.2	10	93	115	259
PAC01	500	6 ±0.5	63 ±1	±1.2	10	85	60	263
PAC02	500	6 ±0.5	63 ±1	±1.2	10	85	60	263
PAC03	500	6 ±0.5	63 ±1	±1.2	10	85	60	263
PAC04	500	6 ±0.5	71 ±1	±1.2	10	97	120	273
PAC05	500	6 ±0.5	71 ±1	±1.2	10	97	120	273
PAC06	500	6 ±0.5	71 ±1	±1.2	10	97	120	273

Linear leaded resistors — Packaging

Table 4 Resistor type, quantities and packaging dimensions for axial taped on **reel**; see Figs 2 and 5

PRODUCT TYPE	QUANTITY	PACKAGING DIMENSIONS						
		AXIAL TAPED ON BANDOLIER				REEL		
		a (mm)	A (mm)	$\lvert B_1 - B_2 \rvert$ (mm)	S (mm)	Q (mm)	V (mm)	R (mm)
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
UXB 0207	5000	6 ±0.5	53 ±2.0	±1.2	5 ±0.5	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
LSR37	5000	6 ±0.5	52 +1.5/–0	±1.2	5	356	75	86
PR01	5000	6 ±0.5	73 ±1.5	±1.2	5	305	90	99
PR01	5000	6 ±0.5	52 ±1.5	±1.2	5	305	75	86
PR02	5000	6 ±0.5	52 ±1.5	±1.2	5	356	75	86

Products with radial leads



For dimensions see Tables 5 and 6.

Fig.6 Bandolier for types with radial leads.

Table 5 Product dependent tape dimensions; see Fig.6

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
		PR02	29	±3.0	mm
		AC01	29	±3.0	mm

Linear leaded resistors

Packaging

Table 6 Tape dimensions; non-product dependent; see Fig.6

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 centre to body centre	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 centre	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 snipped lead	11.0	–	mm
L_1	minimum lead wire (tape portion) shortest lead	2.5	–	mm

LOW POWER PRODUCT DATA

Standard metal film resistors SFR16S/25/25H

FEATURES

- Low cost
- Low noise
- Small size (SFR16S).

APPLICATIONS

- General purpose 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 leads of electrolytic copper are welded to the end-caps.

The resistors are coated with a coloured 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"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE		
	SFR16S	SFR25	SFR25H
Resistance range	1 Ω to 3 MΩ	0.22 Ω to 10 MΩ and jumper (0 Ω)	
Resistance tolerance	±5%, E24 series		
Temperature coefficient:			
$R < 4.7\ \Omega$	$\leq\pm250 \times 10^{-6}$/K	$\leq\pm100 \times 10^{-6}$/K	$\leq\pm100 \times 10^{-6}$/K
$4.7\ \Omega \leq R \leq 100$ kΩ	$\leq\pm100 \times 10^{-6}$/K	$\leq\pm100 \times 10^{-6}$/K	$\leq\pm100 \times 10^{-6}$/K
100 kΩ < R ≤ 1 MΩ	$\leq\pm250 \times 10^{-6}$/K	$\leq\pm100 \times 10^{-6}$/K	$\leq\pm100 \times 10^{-6}$/K
R > 1 MΩ	$\leq\pm250 \times 10^{-6}$/K	$\leq\pm250 \times 10^{-6}$/K	$\leq\pm250 \times 10^{-6}$/K
Absolute maximum dissipation at T_{amb} = 70 °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 kΩ	max. 0.1 μV/V	max. 0.1 μV/V	max. 0.1 μV/V
68 kΩ ≤ R ≤ 100 kΩ	max. 0.5 μV/V	max. 0.1 μV/V	max. 0.1 μV/V
100 kΩ ≤ R ≤ 1 MΩ	max. 1.5 μV/V	max. 0.1 μV/V	max. 0.1 μV/V
R > 1 MΩ	max. 1.5 μV/V	max. 1.5 μV/V	max. 1.5 μV/V
Basic specifications	IEC 60115-1 and 60115-2		
Climatic category (IEC 60068)	55/155/56		
Stability, ΔR/R max., after:			
load:			
R ≤ 1 MΩ	±1% + 0.05 Ω	±1% + 0.05 Ω	±1% + 0.05 Ω
R > 1 MΩ	±1% + 0.05 Ω	±1% + 0.05 Ω	±2% + 0.1 Ω
climatic tests:			
R ≤ 1 MΩ	±1% + 0.05 Ω	±1% + 0.05 Ω	±1% + 0.05 Ω
R > 1 MΩ	±1% + 0.05 Ω	±1% + 0.05 Ω	±2% + 0.1 Ω
soldering	±0.25% + 0.05 Ω	±0.25% + 0.05 Ω	±0.25% + 0.05 Ω
short time overload	±0.25% + 0.05 Ω	±0.25% + 0.05 Ω	±1% + 0.05 Ω

ORDERING INFORMATION

Table 1 Ordering code indicating 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
SFR16S	–	22 187 73...	22 187 53...	22 187 83...
SFR25	06 184 03...	22 181 53...	22 181 43...	22 181 63...
SFR25 jumper[(1)]	–	–	22 181 90019	–
SFR25H	–	22 186 16...	22 186 76...	22 186 26...

Note

1. The jumper has a maximum resistance R_{max} = 10 mΩ at 5 A.

Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 23
- The subsequent 7 digits indicate the resistor type and packaging; see Table 1.
- The remaining 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 2.

Table 2 Last digit of 12NC

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 to 9.76 MΩ	5
10 MΩ	6

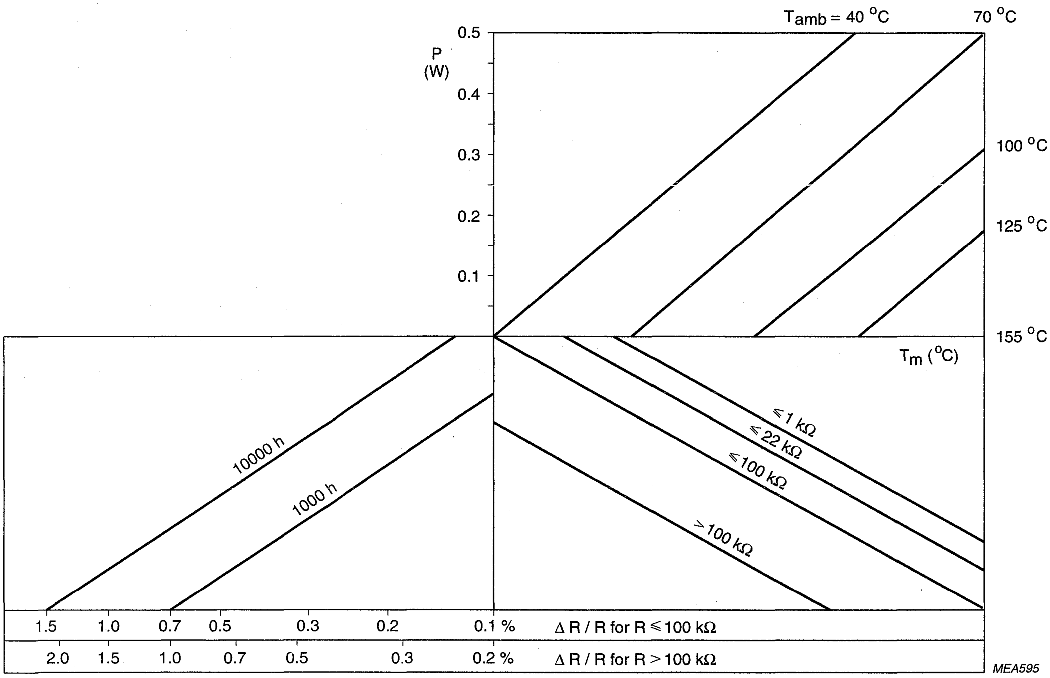
ORDERING EXAMPLE

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

FUNCTIONAL DESCRIPTION

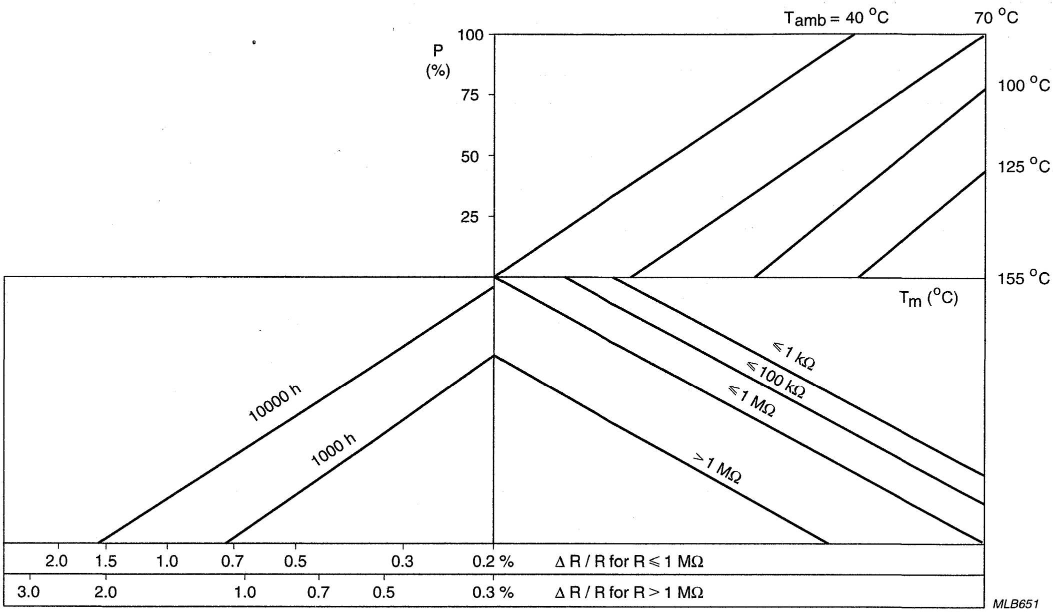
Product characterization

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



SFR16S

Fig.1 Drift nomogram.



SFR25(H)

P_n = 0.4 W (**SFR25**) or 0.5 W (**SFR25H**).

Fig.2 Drift nomogram.

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.

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.3.

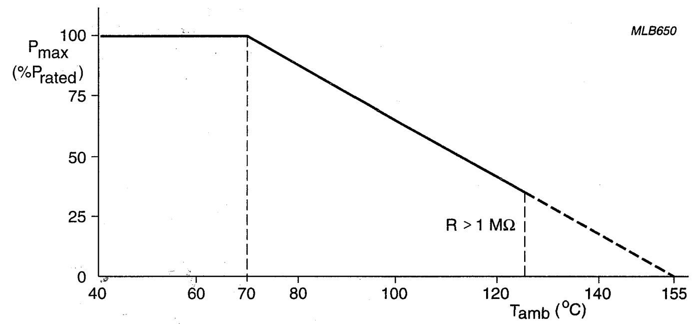


Fig.3 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

PULSE LOADING CAPABILITIES

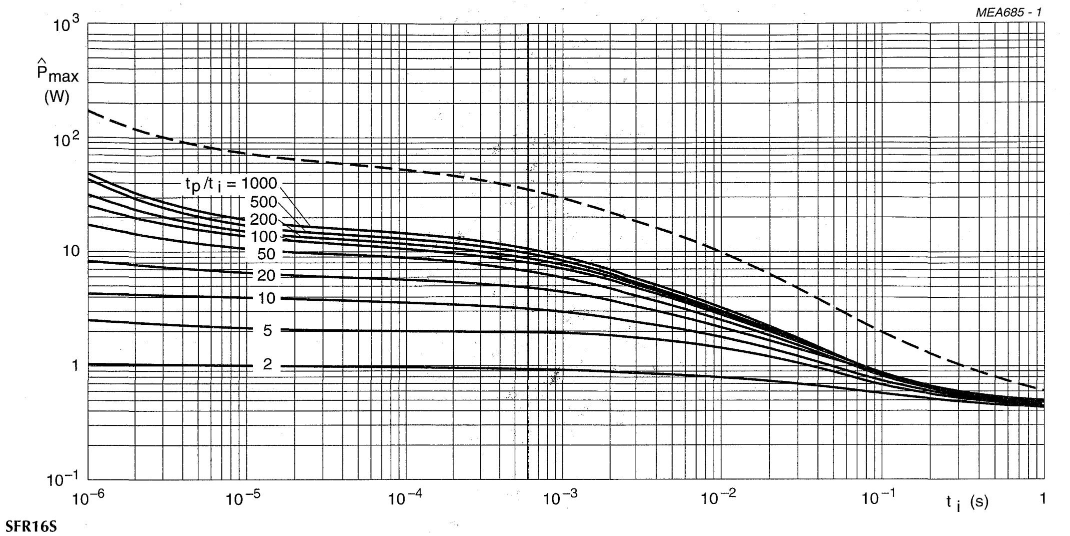


Fig.4 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).

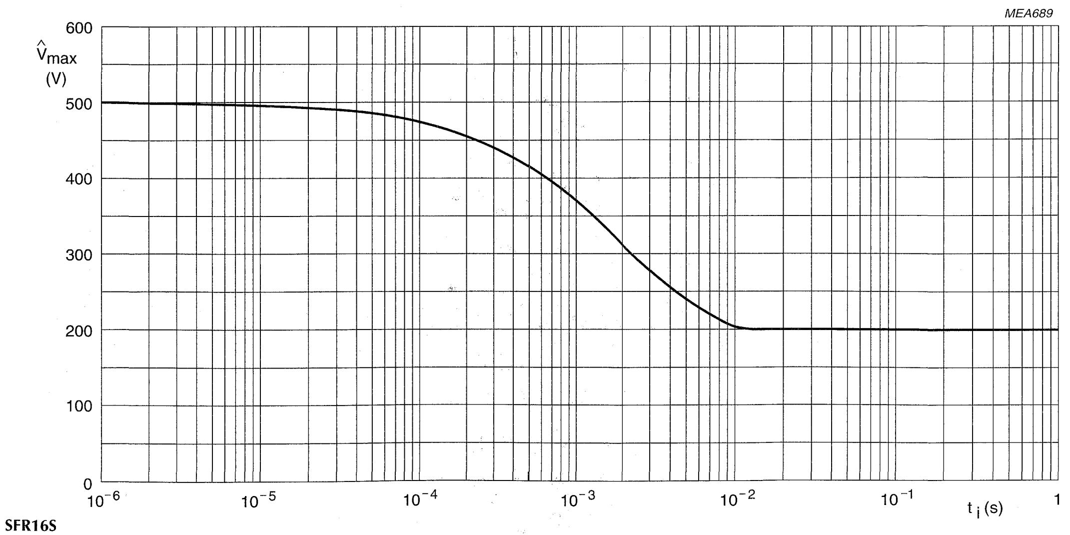
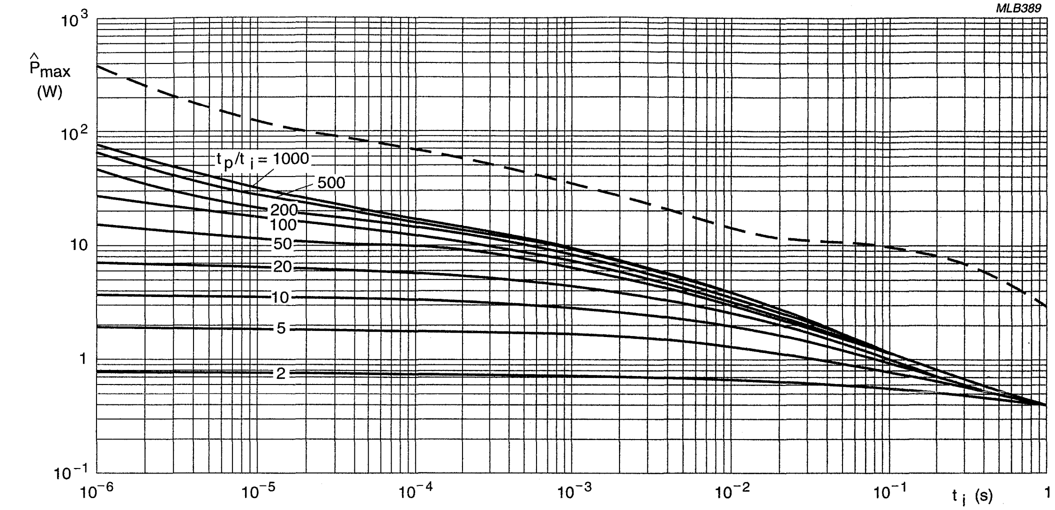
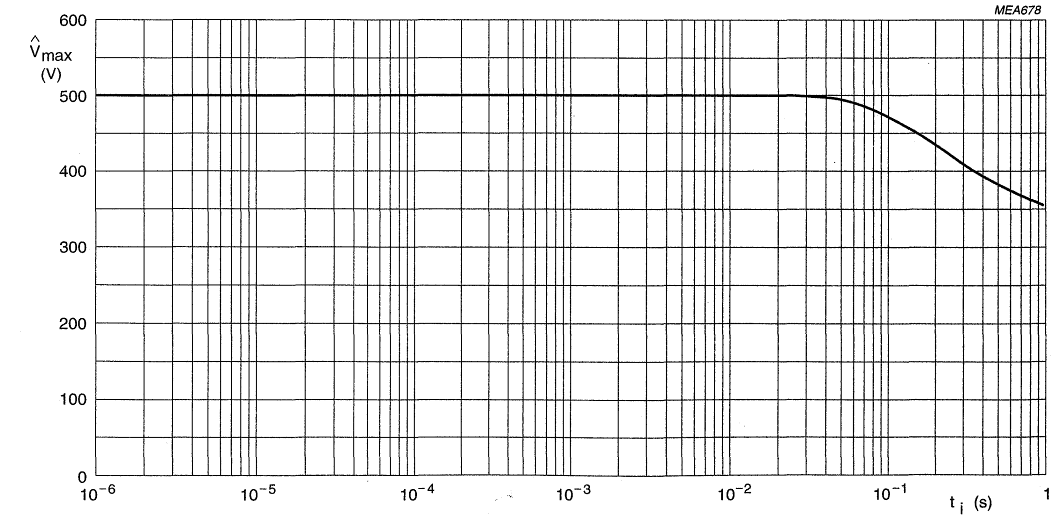


Fig.5 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).



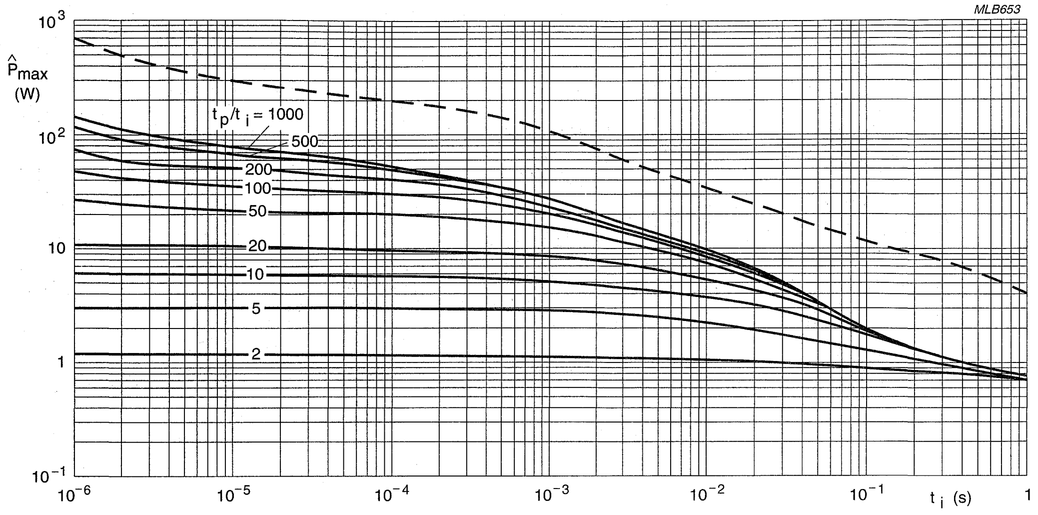
SFR25

Fig.6 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



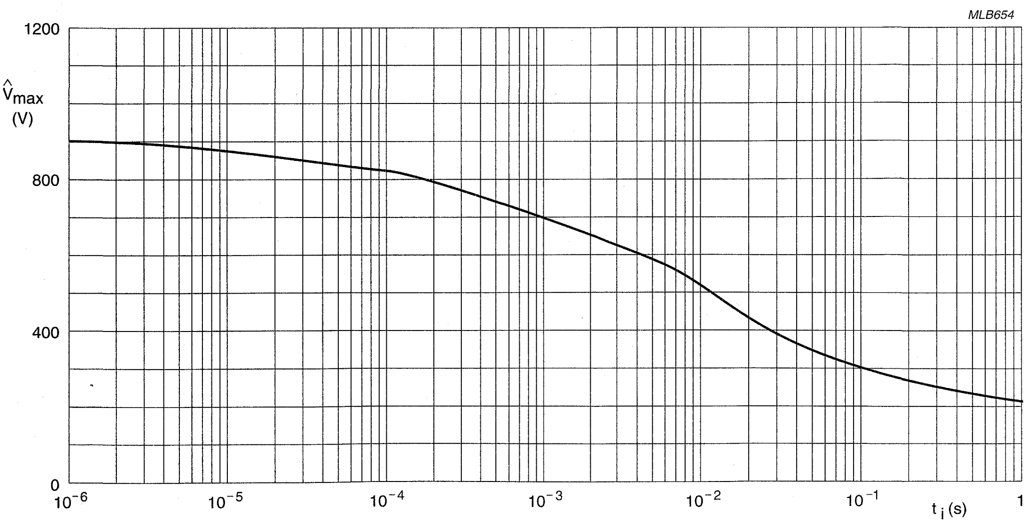
SFR25

Fig.7 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).



SFR25H

Fig.8 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).

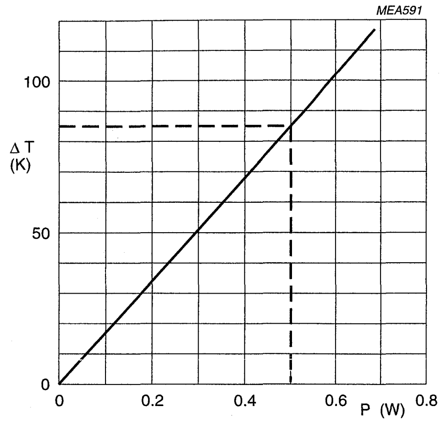


SFR25H

Fig.9 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).

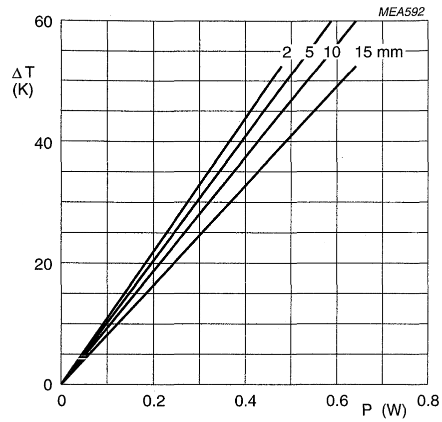
Standard metal film resistors SFR16S/25/25H

Application information



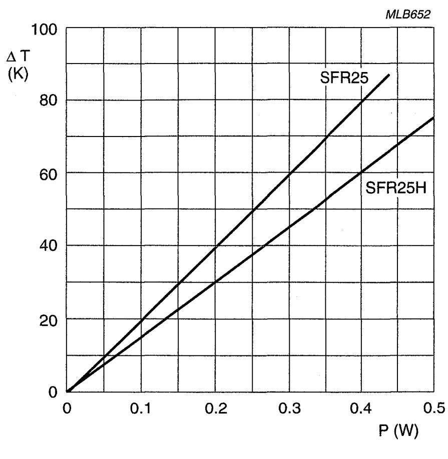
SFR16S

Fig.10 Hot-spot temperature rise (ΔT) as a function of dissipated power.



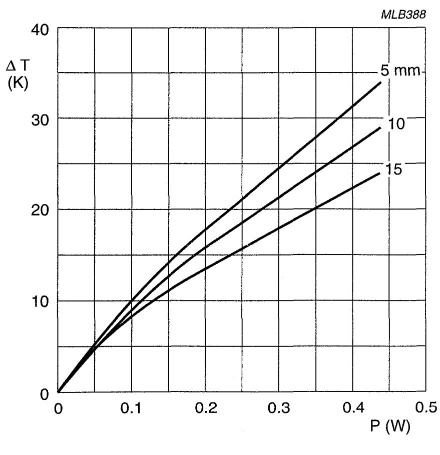
SFR16S

Fig.11 Temperature rise (ΔT) at the end of the lead (soldering point) as a function of dissipated power at various lead lengths after mounting.



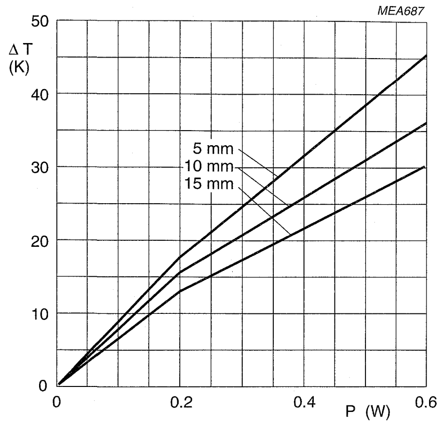
SFR25/SFR25H

Fig.12 Hot-spot temperature rise (ΔT) as a function of dissipated power.



SFR25

Fig.13 Temperature rise (ΔT) at the end of the lead (soldering point) as a function of dissipated power at various lead lengths after mounting.



SFR25H

Fig.14 Temperature rise (ΔT) at the end of the lead (soldering point) as a function of dissipated power at various lead lengths after mounting.

MECHANICAL DATA

Mass per 100 units

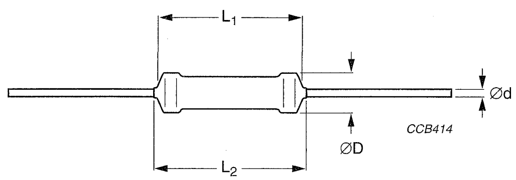
TYPE	MASS (g)
SFR16S	12.5
SFR25	25

Marking

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

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")*.



For dimensions see Table 3.

Fig.15 Outline.

Table 3 Resistor type and relevant physical dimensions; see Fig.15

TYPE	ØD MAX. (mm)	L_1 MAX. (mm)	L_2 MAX. (mm)	Ød (mm)
SFR16S	1.9	3.2	3.4	0.45 ±0.05
SFR25	2.5	6.5	7.0	0.58 ±0.05
SFR25H	2.5	6.5	7.0	0.58 ±0.05

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 Table **4** 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.

Table 4 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:					
4.16.2	21 (Ua1)	tensile all samples	Ø0.45 mm, load 5 N; 10 s Ø0.58 mm, load 10 N; 10 s		number of failures <10 × 10^{-6}		
4.16.3	21 (Ub)	bending half number of samples	Ø0.45 mm, load 2.5 N; 4 × 90° Ø0.58 mm, load 5 N; 4 × 90°		number of failures <10 × 10^{-6}		
4.16.4	21 (Uc)	torsion other half of samples	3 × 360° in opposite directions		no damage ΔR/R max.: ±0.25% + 0.05 Ω		
4.17	20 (Ta)	solderability	2 s; 235 °C; flux 600		good tinning; no damage		
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 6 mm from body		ΔR/R max.: ±0.25% + 0.05 Ω		
4.19	14 (Na)	rapid change of temperature	30 minutes at −55 °C and 30 minutes at +155 °C; 5 cycles		ΔR/R max.: ±0.25% + 0.05 Ω		
4.20	29 (Eb)	bump	3 × 1500 bumps in 3 directions; 40 g		no damage ΔR/R max.: ±0.25% + 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 hours (3 × 2 hours)		no damage ΔR/R max.: ±0.25% + 0.05 Ω		

Standard metal film resistors | SFR16S/25/25H

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					SFR16S	SFR25	SFR25H
4.23		climatic sequence:			R_{ins} min.: 1 000 MΩ		
4.23.2	2 (Ba)	dry heat	16 hours; 155 °C				
4.23.3	30 (Db)	damp heat (accelerated) 1st cycle	24 hours; 55 °C; 90 to 100% RH				
4.23.4	1 (Aa)	cold	2 hours; −55 °C				
4.23.5	13 (M)	low air pressure	2 hours; 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 ≤ 1 MΩ	ΔR/R max.: ±1% + 0.05 Ω		
				R > 1 MΩ	ΔR/R max.: ±1% + 0.05 Ω		ΔR/R max.: ±2% + 0.1 Ω
4.24.2	3 (Ca)	damp heat (steady state)	56 days; 40 °C; 90 to 95% RH; dissipation 0.01 P_n		R_{ins} min.: 1 000 MΩ ΔR/R max.: ±1% + 0.05 Ω		
4.25.1		endurance	1 000 hours at 70 °C; P_n or V_{max}	R ≤ 1 MΩ	ΔR/R max.: ±1% + 0.05 Ω		
				R > 1 MΩ	ΔR/R max.: ±1% + 0.05 Ω		ΔR/R max.: ±2% + 0.1 Ω
4.8.4		temperature coefficient	between −55 °C and +155 °C (TC × 10^{-6}/K)	R < 4.7 Ω	≤±250	≤±100	≤±100
				R ≤ 100 kΩ	≤±100	≤±100	≤±100
				R ≤ 1 MΩ	≤±250	≤±100	≤±100
				R > 1 MΩ	≤±250	≤±250	≤±250
4.7		voltage proof on insulation	400 V (RMS) (**SFR16S**) or 600 V (RMS) (**SFR25** and **SFR25H**); during 1 minute; V-block method		no breakdown		
4.12		noise	*"IEC publication 60195"*	R < 68 kΩ	max. 0.1 µV/V	max. 0.1 µV/V	max. 0.1 µV/V
				R ≤ 100 kΩ	max. 0.5 µV/V	max. 0.1 µV/V	max. 0.1 µV/V
				R ≤ 1 MΩ	max. 1.5 µV/V	max. 0.1 µV/V	max. 0.1 µV/V
				R > 1 MΩ	max. 1.5 µV/V	max. 1.5 µV/V	max. 1.5 µV/V
4.6.1.1		insulation resistance	500 V (DC) during 1 minute; V-block method		R_{ins} min.: 1 000 MΩ		

Standard metal film resistors SFR16S/25/25H

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					SFR16S	**SFR25**	**SFR25H**
4.13		short time overload	room temperature; P = 6.25 × P_n (**SFR25**) or 6.25 × 0.25 W (**SFR16S**); 5 s on, 45 s off (V ≤ 2 × V_{max}); 10 cycles		ΔR/R max.: ±0.25% + 0.05 Ω		ΔR/R max.: ±1% + 0.05 Ω
		intermittent overload in accordance with *"JIS-C5202 5.8"*	16 × 0.16 W; 1 s on and 25 s off; 10000 ±200 cycles; V_{max} = 600 V		ΔR/R max.: ±0.75% + 0.05 Ω	–	–
see 2nd amendment to *"IEC 60115-1"*, Jan. '87		pulse load			see Figs 4, 5, 6, 7, 8 and 9		

Professional leaded resistors

MBA 0204; MBB 0207; MBE 0414

FEATURES

- 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
- Sizes:
  - DIN: 0204; 0207; 0414
  - CECC: A; B; D

APPLICATIONS

- Industrial
- Telecommunication
- Medical equipment.

DESCRIPTION

MBA 0204, MBB 0207 and MBE 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.

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 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**.

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with **CECC 40101-806** which refers to **EN 140000 (IEC 60115-1)** and **EN 140100 (IEC 60115-2).**

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

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**.

QUICK REFERENCE DATA

DESCRIPTION	MBA 0204		MBB 0207		MBE 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		300 V(1)		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	
1 000 h	≤ 0,25%	≤ 0,5%	≤ 0,25%	≤ 0,5%	≤ 0,2%	≤ 0,4%
8 000 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	8 000 h	225 000 h	8 000 h	225 000 h	8 000 h
Permissible voltage against ambient:						
1 minute	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

1. 350 V for 1 000 h.

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[1.]		
T.C.	**TOLERANCE**	**MBA 0204**	**MBB 0207**	**MBE 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
	±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**	–

Note

1. Resistance value to be selected from E24 series for ±5% tolerance, from E24/E96 series for ±1% tolerance and from E24/E192 for ±0,5% tolerance.

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availablility.

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312	
			BANDOLIER IN BOX	
TYPE	**T.C.**	**TOL.**	**C1 1000 units**	**CT 5000 units**
MBA 0204	±50 ppm/K	±5%	900 3....	905 3....
		±1%	900 1....	**905 1....**
		±0,5%	900 5....	905 5....
	±25 ppm/K	±1%	901 1....	906 1....
		±0,5%	901 5....	**906 5....**
	jumper	–	900 90001	**905 90001**
MBB 0207	±50 ppm/K	±5%	910 3....	915 3....
		±1%	910 1....	**915 1....**
		±0,5%	910 5....	915 5....
	±25 ppm/K	±1%	911 1....	916 1....
		±0,5%	911 5....	**916 5....**
	jumper	–	910 90001	**915 90001**
MBE 0414	±50 ppm/K	±5%	920 3....	–
		±1%	**920 1....**	–
		±0,5%	920 5....	–
	±25 ppm/K	±1%	921 1....	–
		±0,5%	**921 5....**	–

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

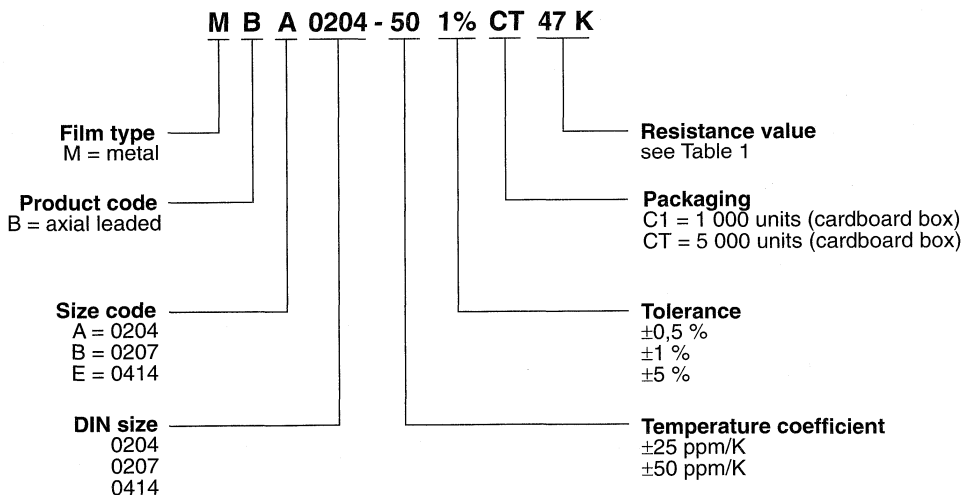
RESISTANCE DECADE	LAST DIGIT
0,1 Ω to 0,999 Ω	7
1 Ω to 9,99 Ω	8
10 Ω to 99,9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9,99 kΩ	2
10 kΩ to 99,9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9,99 MΩ	5
10 MΩ to 99,9 MΩ	6

ORDERING EXAMPLE

The ordering code of a MBA 0204 resistor, value 47 kΩ and TC 50 with ±1% tolerance, supplied on bandolier in a box of 5000 units is: 2312 905 14703.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



Jumpers are ordered by the resistance value 0 Ω, e.g. MBA 0204 CT 0R0.

FUNCTIONAL DESCRIPTION

Derating

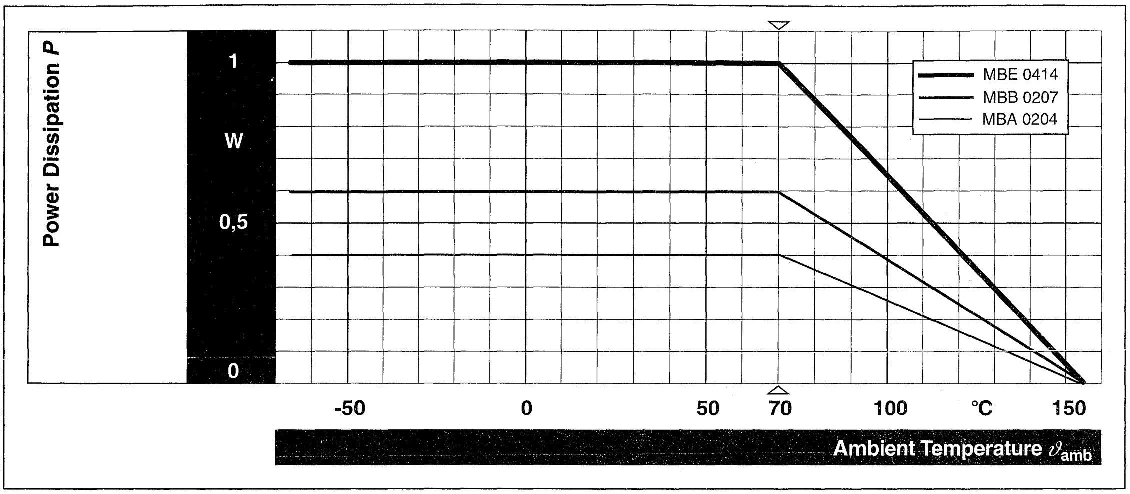


Fig.1 Derating, standard operation.

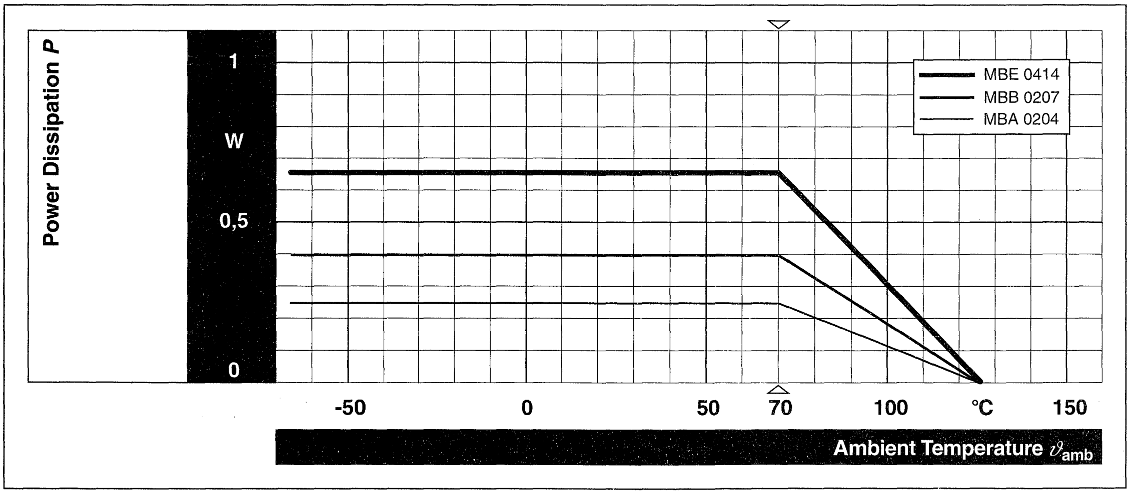


Fig.2 Derating, long term operation.

Temperature rise

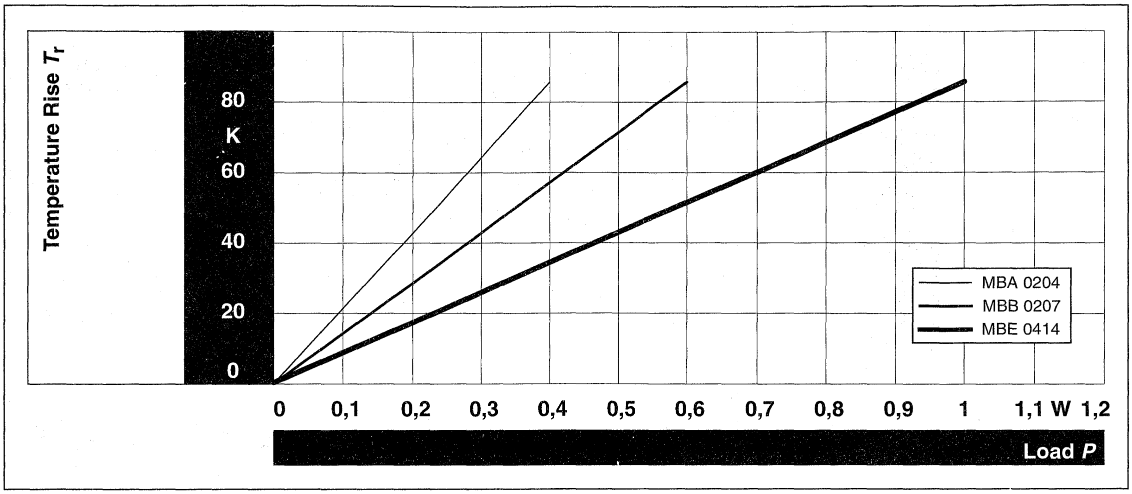


Fig.3 Rise of the surface temperature.

Single pulse

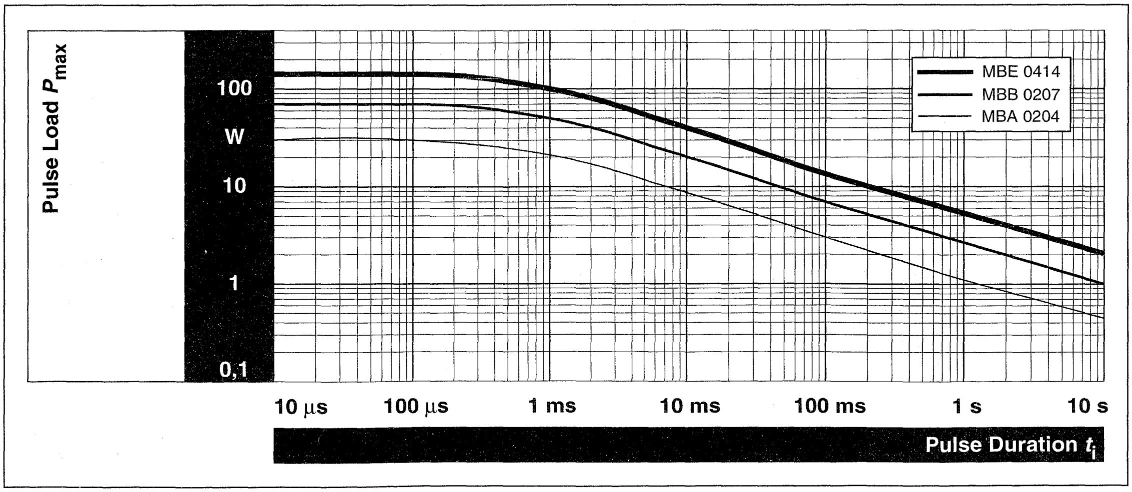


Fig.4 Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation.

Continuous pulses

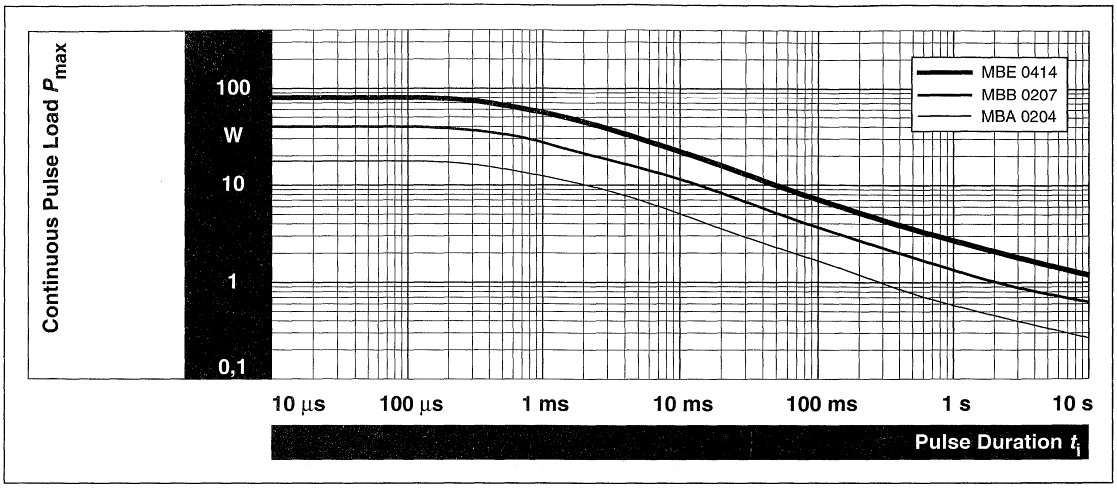


Fig.5 Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Pulse voltage

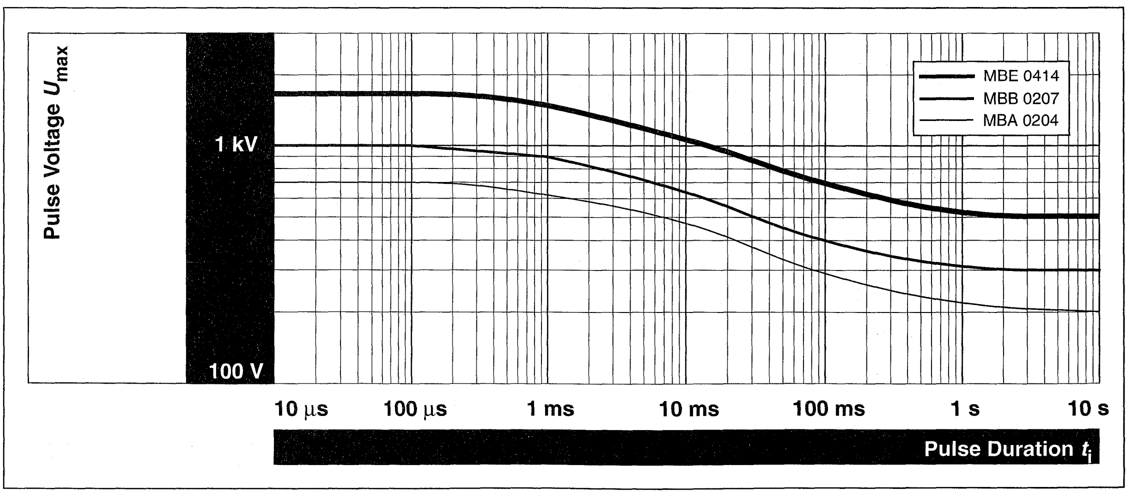


Fig.6 Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation.

1,2/50 pulse

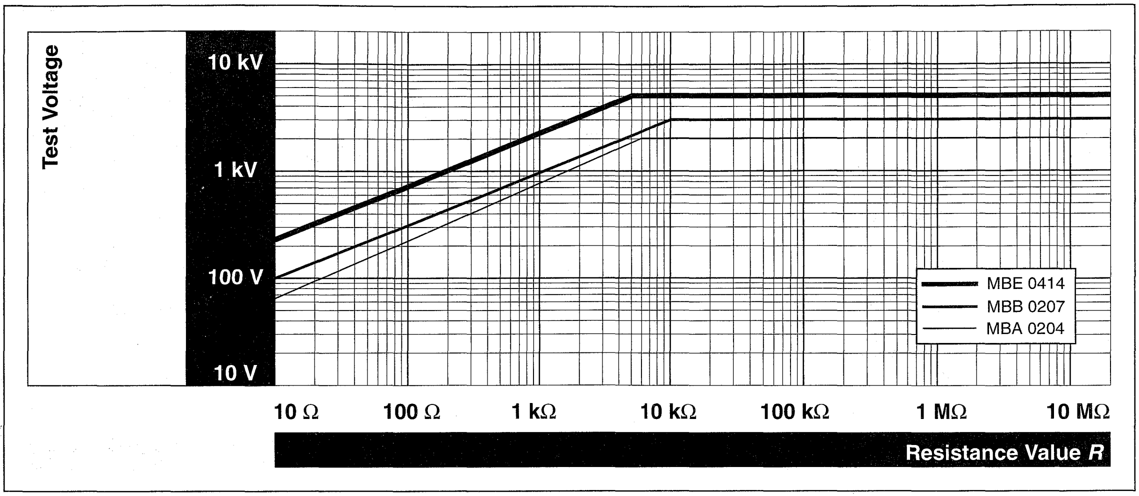


Fig.7 Pulse load rating in accordance with IEC 60115-1, 4.27; 1,2 μs / 50 μs; 5 pulses at 12 s intervals; for permissible resistance change 0,5%.

10/700 pulse

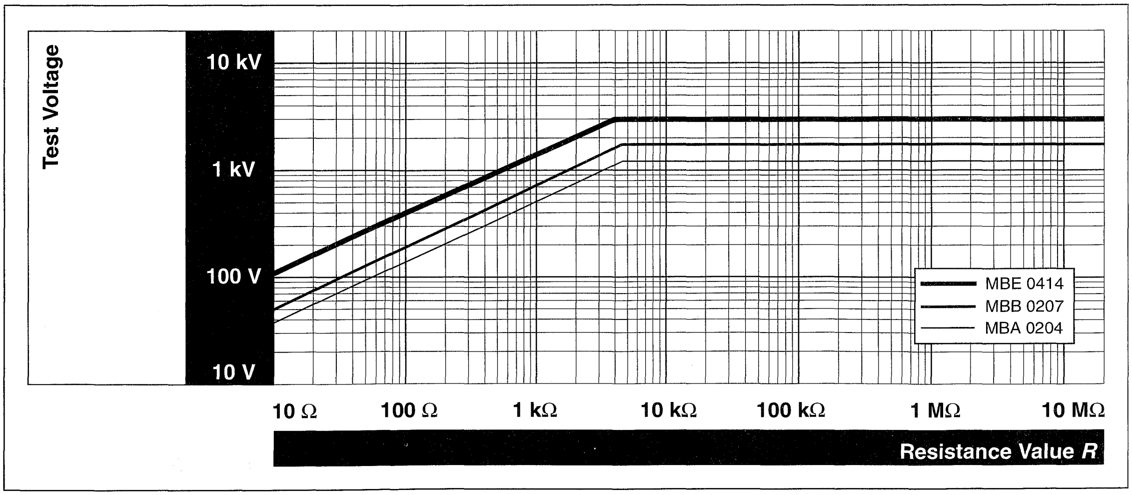


Fig.8 Pulse load rating in accordance with IEC 60115-1, 4.27; 10 μs / 700 μs; 10 pulses at 1 minute intervals; for permissible resistance change 0,5%.

Current noise

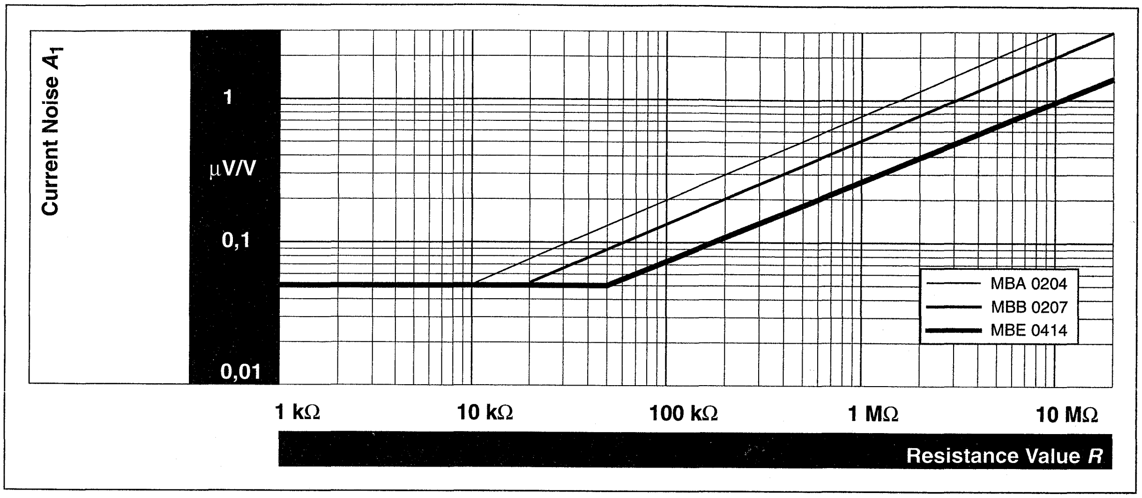


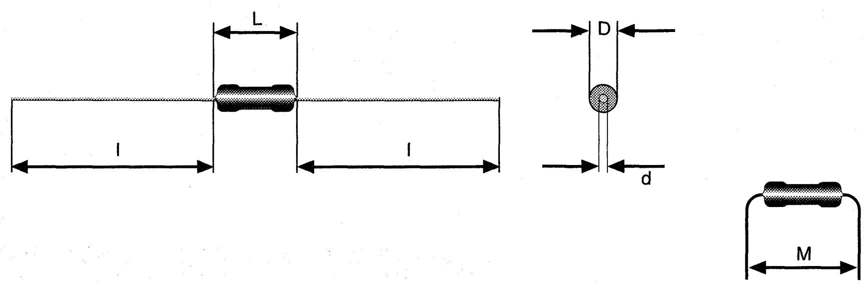
Fig.9 Current noise A_1 in accordance with IEC 60195.

Professional leaded resistors

MBA 0204; MBB 0207; MBE 0414

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.10 Outlines.

Table 4 Leaded resistor types, mass and relevant physical dimensions; see Fig.10

TYPE	D_{max} (mm)	L_{max} (mm)	d_{nom} (mm)	l_{min} (mm)	M_{min} (mm)	MASS (mg)
MBA 0204	1,6	3,6	0,5	29,0	5,0	125
MBB 0207	2,5	6,3	0,6	28,0	10,0[1]	220
MBE 0414	4,0	11,9	0,8	31,0	15,0	700

Note

1. For 7,5 ≤ M < 10,0 mm, use version MBB 0207 ... L0 without lacquer on the leads.

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. Table 5 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)		
			stability for product types:	**STABILITY CLASS 0,5**	**STABILITY CLASS 1**	**STABILITY CLASS 2**
			MBA 0204	1 Ω to 332 kΩ	0,22 Ω to < 1 Ω	> 332 kΩ
			MBB 0207	1 Ω to 1 MΩ	0,22 Ω to < 1 Ω	> 1 MΩ
			MBE 0414	1 Ω to 2,4 MΩ	0,22 Ω to < 1 Ω	> 2,4 MΩ
4.5	–	resistance		±5%; ±1%; ±0,5%		
4.8.4.2	–	temperature coefficient	at 20 / LCT / 20 °C and 20 / UCT / 20 °C	±50 ppm/K; ±25 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; 1000 h	±(0,5% + 0,05 Ω)	±(0,5% + 0,05 Ω)	±0,5%
			70 °C; 8000 h	±(1% + 0,05 Ω)	±(1% + 0,05 Ω)	±1%
4.25.3	–	endurance at upper category temperature	155 °C; 1000 h	±(0,5% + 0,05 Ω)	±(1% + 0,05 Ω)	±2%
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±(0,5% + 0,05 Ω)	±(1% + 0,05 Ω)	±2%

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)		
			stability for product types:	STABILITY CLASS 0,5	STABILITY CLASS 1	STABILITY CLASS 2
			MBA 0204	1 Ω to 332 kΩ	0,22 Ω to < 1 Ω	> 332 kΩ
			MBB 0207	1 Ω to 1 MΩ	0,22 Ω to < 1 Ω	> 1 MΩ
			MBE 0414	1 Ω to 2,4 MΩ	0,22 Ω to < 1 Ω	> 2,4 MΩ
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 to 35 °C			
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	±(0,5% + 0,05 Ω) no visible damage	±(1% + 0,05 Ω) no visible damage	±2% no visible damage
–	1 (Aa)	cold	−55 °C; 2 h	±(0,1% + 0,01 Ω)	±(0,25% + 0,05 Ω)	±0,5%
4.13	–	short time overload	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±(0,1% + 0,01 Ω) no visible damage	±(0,25% + 0,05 Ω) no visible damage	±0,5% no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±(0,1 % + 0,01 Ω) no visible damage	±(0,25% + 0,05 Ω) no visible damage	±0,5% 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 ± 5 °C; 10 ± 1 s	±(0,1% + 0,01 Ω) no visible damage	±(0,25% + 0,05 Ω) no visible damage	±0,5% no visible damage
4.17	20 (Ta)	solderability	+235 °C; 2 s solder bath method	good tinning (≥ 95% covered); no visible damage		
4.22	6 (B4)	vibration	6 h; 10 to 2000 Hz 1,5 mm or 196 m/s^2	±(0,1% + 0,01 Ω)	±(0,25% + 0,05 Ω)	±0,5%
4.16	21 (Ua_1) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	±(0,1% + 0,01 Ω)	±(0,25% + 0,05 Ω)	±0,5%
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown		

Precision leaded resistors

MBA 0204; MBB 0207; MBE 0414

FEATURES

- Advanced thin film technology
- Low TC: ±15 to ±25 ppm/K
- Precision tolerance of value: ±0,1% and ±0,25%
- Superior overall stability: class 0,05
- Wide precision range: 10 Ω to 1,5 MΩ
- Sizes:
  - DIN: 0204; 0207; 0414
  - CECC: A; B; D;

APPLICATIONS

- Test and measuring equipment
- Industrial electronics
- Medical electronics.

DESCRIPTION

MBA 0204, MBB 0207 and MBE 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.

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 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 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**.

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with **CECC 40101-806** which refers to **EN 140000 (IEC 60115-1)** and **EN 140100 (IEC 60115-2).**

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

Precision leaded resistors

MBA 0204; MBB 0207; MBE 0414

QUICK REFERENCE DATA

DESCRIPTION	MBA 0204		MBB 0207		MBE 0414	
CECC size	A		B		D	
Resistance range	22 Ω to 332 kΩ		10 Ω to 1 MΩ		22 Ω to 1,5 MΩ	
Resistance tolerance	±0,25%; ±0,1%					
Temperature coefficient	±25 ppm/K; ±15 ppm/K					
Operation mode	precision	long term	precision	long term	precision	long term
Climatic category (LCT/UCT/days)	55/85/56	55/125/56	55/85/56	55/125/56	55/85/56	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		300 V		500 V	
Film temperature	85 °C	125 °C	85 °C	125 °C	85 °C	125 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	100 Ω to 100 kΩ		100 Ω to 270 kΩ		100 Ω to 470 kΩ	
1000 h	≤ 0,05%	≤ 0,25%	≤ 0,03%	≤ 0,15%	≤ 0,05%	≤ 0,25%
8000 h	≤ 0,1%	≤ 0,5%	≤ 0,1%	≤ 0,5%	≤ 0,1%	≤ 0,5%
225000 h	≤ 0,3%	≤ 1,5%	≤ 0,3%	≤ 1,5%	≤ 0,3%	≤ 1,5%
Specified lifetime	225000 h		225000 h		225000 h	
Permissible voltage against ambient :						
1 minute	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	

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[1]		
T.C.	TOLERANCE	MBA 0204	MBB 0207	MBE 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**

Note

1. Resistance values to be selected from E96 and E192 series, for other values please contact factory.

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Precision leaded resistors

MBA 0204; MBB 0207; MBE 0414

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312	
			BANDOLIER IN BOX	
TYPE	T.C.	TOL.	C1 1000 units	CT 5000 units
MBA 0204	±25 ppm/K	±0,25%	901 6....	**906 6....**
		±0,1%	901 7....	**906 7....**
	±15 ppm/K	±0,25%	902 6....	907 6....
		±0,1%	902 7....	**907 7....**
MBB 0207	±25 ppm/K	±0,25%	911 6....	**916 6....**
		±0,1%	911 7....	**916 7....**
	±15 ppm/K	±0,25%	912 6....	917 6....
		±0,1%	912 7....	**917 7....**
MBE 0414	±25 ppm/K	±0,25%	**921 6....**	–
		±0,1%	**921 7....**	–
	±15 ppm/K	±0,25%	922 6....	–
		±0,1%	**922 7....**	–

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

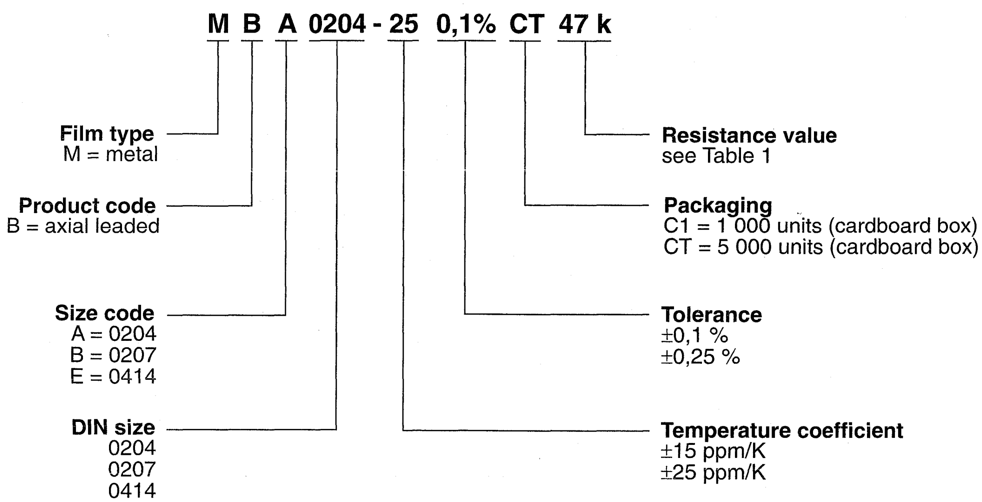
RESISTANCE DECADE	LAST DIGIT
10 Ω to 99,9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9,99 kΩ	2
10 kΩ to 99,9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9,99 MΩ	5

ORDERING EXAMPLE

The ordering code of a MBA 0204 resistor, value 47 kΩ and TC 25 with ±0,1% tolerance, supplied on bandolier in a box of 5000 units is: 2312 906 74703.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



FUNCTIONAL DESCRIPTION

Derating

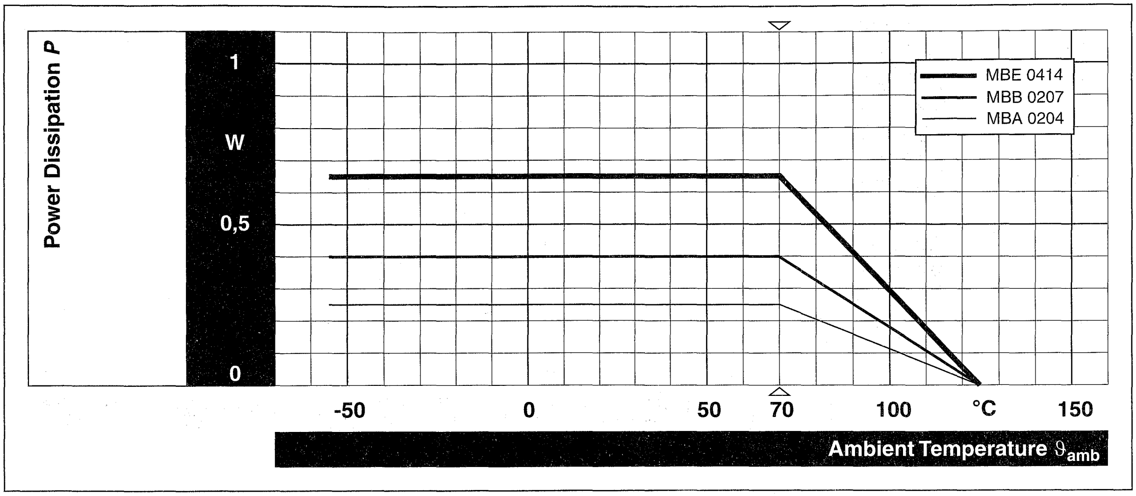


Fig.1 Derating, long term operation.

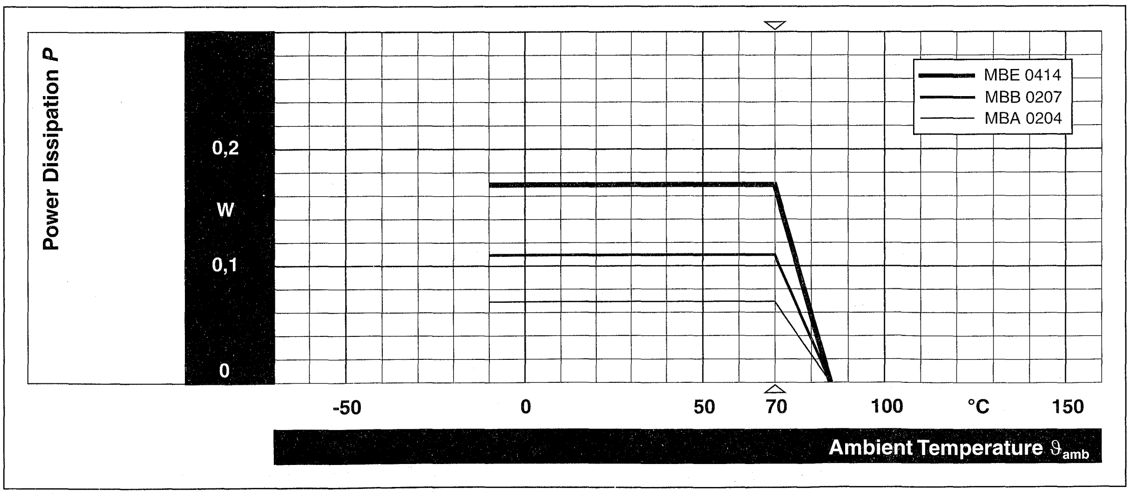


Fig.2 Derating, precision operation.

Temperature rise

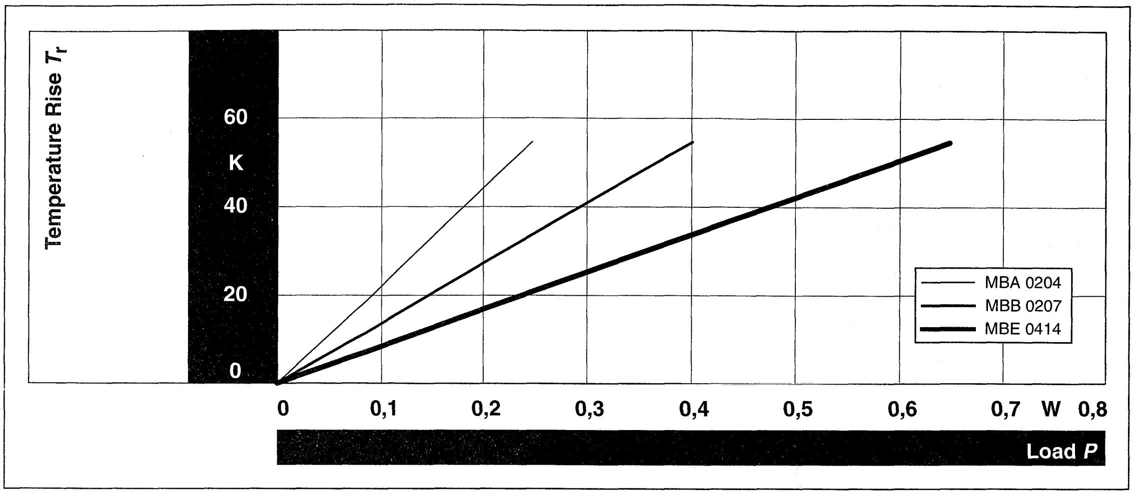


Fig.3 Rise of the surface temperature.

Current noise

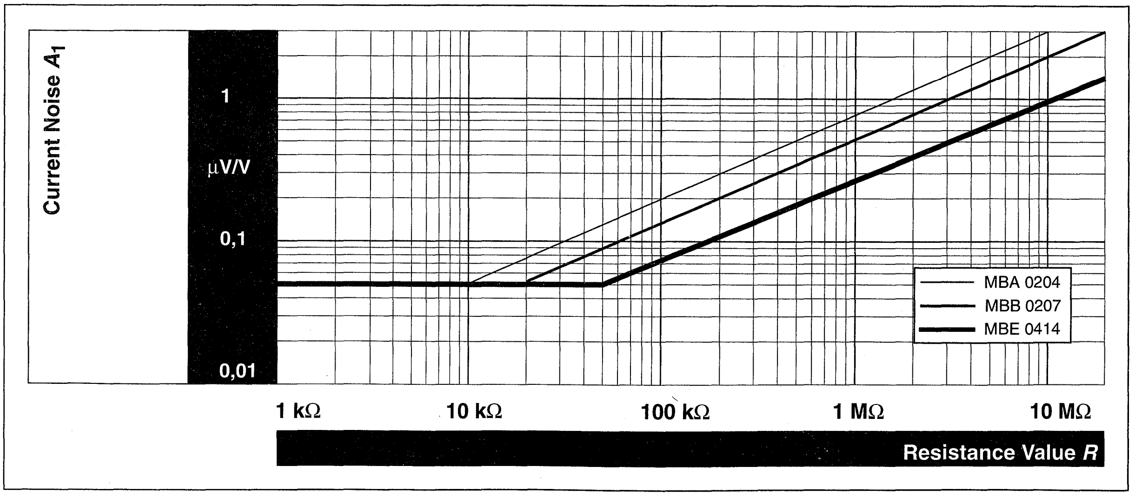
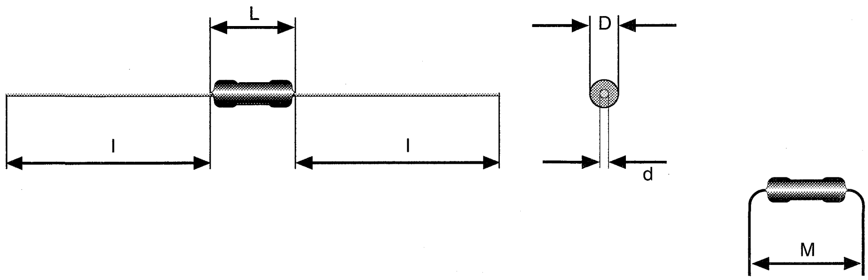


Fig.4 Current noise A_1 in accordance with IEC 60195.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.5 Outlines.

Table 4 Leaded resistor types, mass and relevant physical dimensions; see Fig.5

TYPE	D_{max} (mm)	L_{max} (mm)	d_{nom} (mm)	l_{min} (mm)	M_{min} (mm)	MASS (mg)
MBA 0204	1,6	3,6	0,5	29,0	5,0	125
MBB 0207	2,5	6,3	0,6	28,0	10,0[1]	220
MBE 0414	4,0	11,9	0,8	31,0	15,0	700

Note

1. For 7,5 ≤ M < 10,0 mm, use version MBB 0207 ... L0 without lacquer on the leads.

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. Table 5 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)		
			stability for product types:	STABILITY CLASS 0,05	STABILITY CLASS 0,1	STABILITY CLASS 0,25
			MBA 0204	100 Ω to 100 kΩ	43 Ω to <100 Ω; >100 k to 221 kΩ	22 Ω to <43 Ω; >221 kΩ to 332 kΩ
			MBB 0207	100 Ω to 270 kΩ	43 Ω to <100 Ω; >270 kΩ to 510 kΩ	10 Ω to <43 Ω; > 510 kΩ to 1 MΩ
			MBE 0414	100 Ω to 470 kΩ	43 Ω to <100 Ω; >470 kΩ to 1 MΩ	22 Ω to <43 Ω; >1 MΩ to 1,5 MΩ
4.5	–	resistance	–	±0,25%; ±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	room temperature; $U = \sqrt{P_{70} \times R}$ or $U = U_{max}$; 1,5 h on; 0,5 h off			
			70 °C; 1000 h	±(0,05% + 0,01 Ω)(1)	±(0,1% + 0,01 Ω)	±(0,25% + 0,05 Ω)(2)
			70 °C; 8000 h	±(0,1% + 0,01 Ω)	±(0,2% + 0,01 Ω)	±(0,5% + 0,05 Ω)
4.25.3	–	endurance at upper category temperature	125 °C; 1 000 h	–	–	±(0,25% + 0,05 Ω)
			85 °C; 1 000 h	±(0,05% + 0,01 Ω)	±(0,1% + 0,01 Ω)	–

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)		
			stability for product types:	**STABILITY CLASS 0,05**	**STABILITY CLASS 0,1**	**STABILITY CLASS 0,25**
			MBA 0204	100 Ω to 100 kΩ	43 Ω to <100 Ω; >100 kΩ to 221 kΩ	22 Ω to <43 Ω; >221 kΩ to 332 kΩ
			MBB 0207	100 Ω to 270 kΩ	43 Ω to <100 Ω; >270 kΩ to 510 kΩ	10 Ω to <43 Ω; > 510 kΩ to 1 MΩ
			MBE 0414	100 Ω to 470 kΩ	43 Ω to <100 Ω; >470 kΩ to 1 MΩ	22 Ω to <43 Ω; >1 MΩ to 1,5 MΩ
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±(0,05% + 0,01 Ω)	±(0,1% + 0,01 Ω)	±(0,25% + 0,05 Ω)
4.23		climatic sequence:				
4.23.2	2 (Ba)	dry heat	125 °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 to 35 °C			
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100% RH; 5 cycles	±(0,05%+ 0,01 Ω) no visible damage	±(0,1%+ 0,01 Ω) no visible damage	±(0,25%+ 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	±(0,01% + 0,01 Ω) no visible damage	±(0,02% + 0,01 Ω) no visible damage	±(0,05% + 0,01 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±(0,01% + 0,01 Ω) no visible damage	±(0,02% + 0,01 Ω) no visible damage	±(0,05% + 0,01 Ω) 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 ± 5 °C; 10 ± 1 s	±(0,01% + 0,01 Ω) no visible damage	±(0,02% + 0,01 Ω) no visible damage	±(0,05% + 0,01 Ω) no visible damage
4.17	20 (Ta)	solderability	+235 °C; 2 s solder bath method	good tinning (≥ 95 covered); no visible damage		
4.22	6 (B4)	vibration	6 h; 10 to 2 000 Hz 1,5 mm or 196 m/s^2	±(0,01% + 0,01 Ω)	±(0,02% + 0,01 Ω)	±(0,05% + 0,01 Ω)

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)		
			stability for product types:	**STABILITY CLASS 0,05**	**STABILITY CLASS 0,1**	**STABILITY CLASS 0,25**
			MBA 0204	100 Ω to 100 kΩ	43 Ω to <100 Ω; >100 kΩ to 221 kΩ	22 Ω to <43 Ω; >221 kΩ to 332 kΩ
			MBB 0207	100 Ω to 270 kΩ	43 Ω to <100 Ω; >270 kΩ to 510 kΩ	10 Ω to <43 Ω; > 510 kΩ to 1 MΩ
			MBE 0414	100 Ω to 470 kΩ	43 Ω to <100 Ω; >470 kΩ to 1 MΩ	22 Ω to <43 Ω; >1 MΩ to 1,5 MΩ
4.16	21 (Ua_1) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	±(0,01% + 0,01 Ω)	±(0,02% + 0,01 Ω)	±(0,05% + 0,01 Ω)
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown		

Notes

1. ±(0,03% + 0,01 Ω) for MBB 0207.
2. ±(0,15% + 0,05 Ω) for MBB 0207.

Ultra precision leaded resistors

UXA 0204; UXB 0207; UXC 0309

FEATURES

- Superior thin film technology
- Exceptional low TC: ±02 to ±10 ppm/K
- Super tight tolerance: ±0,01 to ±0,25%
- Exceptional overall stability: class 0,02
- Wide ultra precision range: 22 Ω to 301 kΩ
- Sizes:
  - DIN: 0204; 0207; 0309
  - CECC: A; B; C.

APPLICATIONS

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

DESCRIPTION

UXA 0204, UXB 0207 and UXC 0309 ultra 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.

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. 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 tin alloy 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 TC 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**.

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. They are suitable for automatic reflow soldering. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with **CECC 40101-806** which refers to **EN 140000 (IEC 60115-1)** and **EN 140100 (IEC 60115-2).**

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

The UXC 0309 is a replacement for the obsolete MPR34.

Ultra precision leaded resistors

UXA 0204; UXB 0207; UXC 0309

QUICK REFERENCE DATA

DESCRIPTION	UXA 0204	UXB 0207	UXC 0309
CECC size	A	B	C
Resistance range	22 Ω to 221 kΩ	10 Ω to 1 MΩ	10 Ω to 1 MΩ
Resistance tolerance	±0,25%; ±0,1%; ±0,05%; ±0,01%		
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	0,4 W
Operating voltage, U_{max} AC/DC	200 V	250 V	350 V
Film temperature	125 °C	125 °C	125 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	100 Ω to 100 kΩ	100 Ω to 250 kΩ	24 Ω to 100 kΩ
2 000 h	≤ 0,05%	≤ 0,05%	≤ 0,05%
Max. resistance change at P_{85} for resistance range, $\Delta R/R$ max., after:	100 Ω to 100 kΩ	100 Ω to 250 kΩ	10 Ω to 1 MΩ
1 000 h	≤ 0,02%	≤ 0,02%	≤ 0,02%
8000 h	≤ 0,04%	≤ 0,04%	≤ 0,04%
225000 h	≤ 0,12%	≤ 0,12%	≤ 0,12%
Specified lifetime	225000 h	225000 h	225000 h
Permissible voltage against ambient :			
1 minute	300 V	500 V	800 V
continuous	75 V	75 V	75 V
Failure rate	≤ $0{,}7 \times 10^{-9}$/h	≤ $0{,}3 \times 10^{-9}$/h	≤ $0{,}2 \times 10^{-9}$/h

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[1]		
T.C.	TOLERANCE	UXA 0204	UXB 0207	UXC 0309
±10 ppm/K[2]	±0,25%	22 Ω to 221 kΩ	10 Ω to 1 MΩ	10 Ω to 1 MΩ
	±0,1%	43 Ω to 221 kΩ	10 Ω to 1 MΩ	10 Ω to 1 MΩ
	±0,05%	100 Ω to 180 kΩ	24 Ω to 301 kΩ	24 Ω to 100 kΩ
	±0,01%	200 Ω to 150 kΩ	24 Ω to 301 kΩ	24 Ω to 100 kΩ
±05 ppm/K[2]	±0,25%	47 Ω to 150 kΩ	10 Ω to 1 MΩ	10 Ω to 1 MΩ
	±0,1%	47 Ω to 150 kΩ	10 Ω to 1 MΩ	10 Ω to 1 MΩ
	±0,05%	100 Ω to 150 kΩ	24 Ω to 221 kΩ	24 Ω to 100 kΩ
	±0,01%	200 Ω to 150 kΩ	24 Ω to 221 kΩ	24 Ω to 100 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. TC 10 and TC 05 are specified over the temperature range from –20 °C to + 85 °C.
3. TC 02 is specified over the temperature range from 0 °C to +60 °C.

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312		
			BULK[1]	BANDOLIER IN BOX	BANDOLIER ON REEL
TYPE	T.C.	TOL.	100 units	C1 1000 units	RP 5000 units
UXA 0204	±10 ppm/K	±0,25%	562 2....	662 2....	–
		±0,1%	562 3....	662 3....	–
		±0,05%	562 4....	662 4....	–
		±0,01%	562 7....	662 7....	–
		note 2	562 91...	662 91...	–
	±05 ppm/K	±0,25%	563 2....	663 2....	–
		±0,1%	563 3....	663 3....	–
		±0,05%	563 4....	663 4....	–
		±0,01%	563 7....	663 7....	–
		note 2	563 91...	663 91...	–
	±02 ppm/K	±0,25%	564 2....	664 2....	–
		±0,1%	564 3....	664 3....	–
		±0,05%	564 4....	664 4....	–
		±0,01%	564 7....	664 7....	–
		note 2	564 91...	664 91...	–

Ultra precision leaded resistors

UXA 0204; UXB 0207; UXC 0309

DESCRIPTION			ORDERING CODE 2312		
			BULK[(1)]	BANDOLIER IN BOX	BANDOLIER ON REEL
TYPE	T.C.	TOL.	100 units	C1 1000 units	RP 5000 units
UXB 0207	±10 ppm/K	±0,25%	572 2....	672 2....	577 2....
		±0,1%	572 3....	672 3....	577 3....
		±0,05%	572 4....	672 4....	577 4....
		±0,01%	572 7....	672 7....	577 7....
		note 2	572 91...	672 91...	577 91...
	±05 ppm/K	±0,25%	573 2....	673 2....	578 2....
		±0,1%	573 3....	673 3....	578 3....
		±0,05%	573 4....	673 4....	578 4....
		±0,01%	573 7....	673 7....	578 7....
		note 2	573 91...	673 91....	578 91...
	±02 ppm/K	±0,25%	574 2....	674 2....	579 2....
		±0,1%	574 3....	674 3....	579 3....
		±0,05%	574 4....	674 4....	579 4....
		±0,01%	574 7....	674 7....	579 7....
		note 2	574 91...	674 91...	579 91...
UXC 0309	±10 ppm/K	±0,25%	582 2....	682 2....	–
		±0,1%	582 3....	682 3....	–
		±0,05%	582 4....	682 4....	–
		±0,01%	582 7....	682 7....	–
		note 2	582 91...	682 91...	–
	±05 ppm/K	±0,25%	583 2....	683 2....	–
		±0,1%	583 3....	683 3....	–
		±0,05%	583 4....	683 4....	–
		±0,01%	583 7....	683 7....	–
		note 2	583 91...	683 91...	–

Notes

1. Bulk products are available without packaging codes in multiples of 100 units and delivered in tape length(s), loose in a plastic bag or container, according to availability.
2. 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.

Table 3 Last digit of 12NC indicating resistance decade

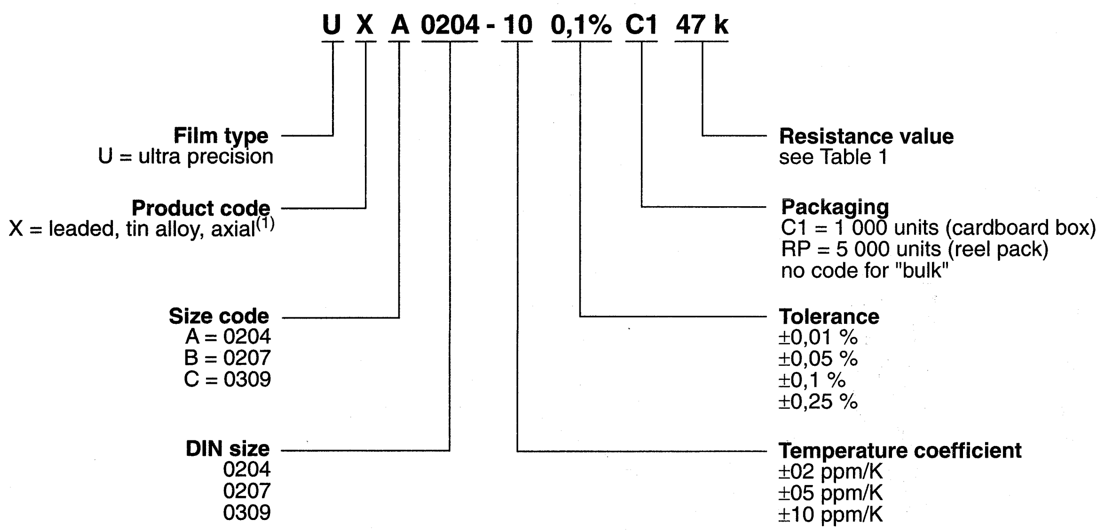
RESISTANCE DECADE	LAST DIGIT
10 Ω to 99,9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9,99 kΩ	2
10 kΩ to 99,9 kΩ	3
100 kΩ to 999 kΩ	4

ORDERING EXAMPLE

The ordering code of a UXA 0204 resistor, value 47 kΩ and TC 10 with ±0,1% tolerance, supplied on bandolier in a box of 1 000 units is: 2312 662 34703.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



(1) 2% Pb, in order to comply with demands of the U.S. Bellcore specification.

FUNCTIONAL DESCRIPTION

Derating, precision operation

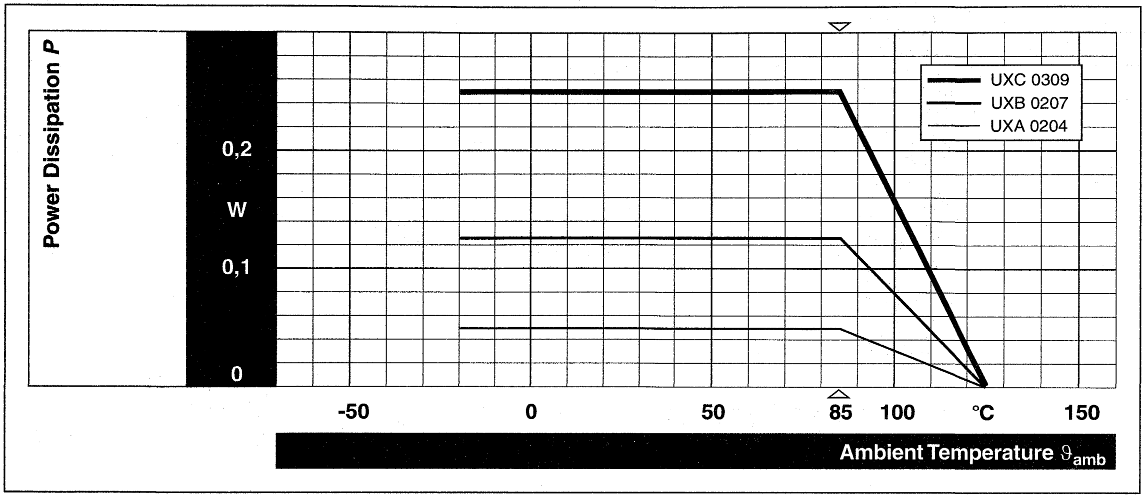


Fig.1 Derating, precision operation. Specification for TC 02 is valid from 0°C to 60°C.

Temperature rise

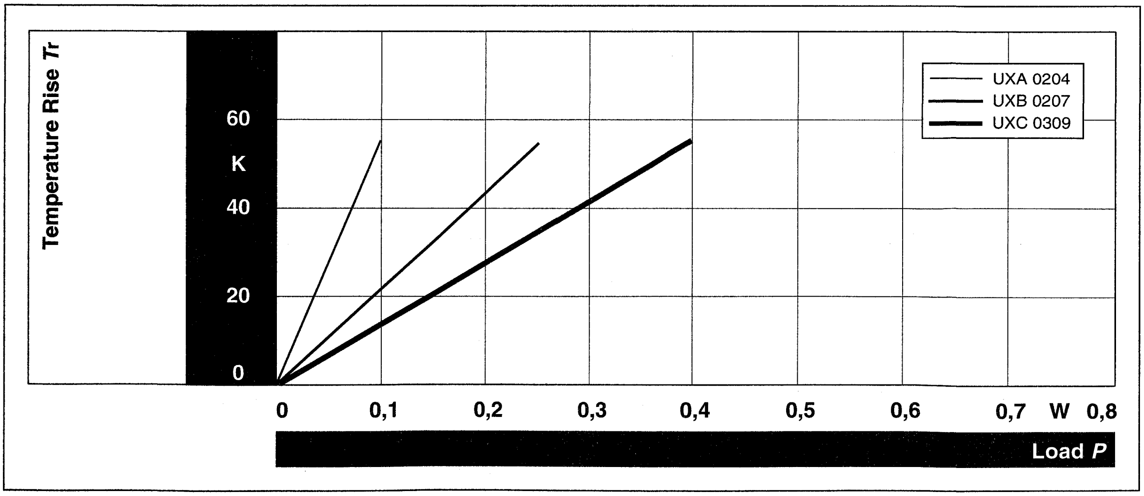


Fig.2 Rise of the surface temperature.

Current noise

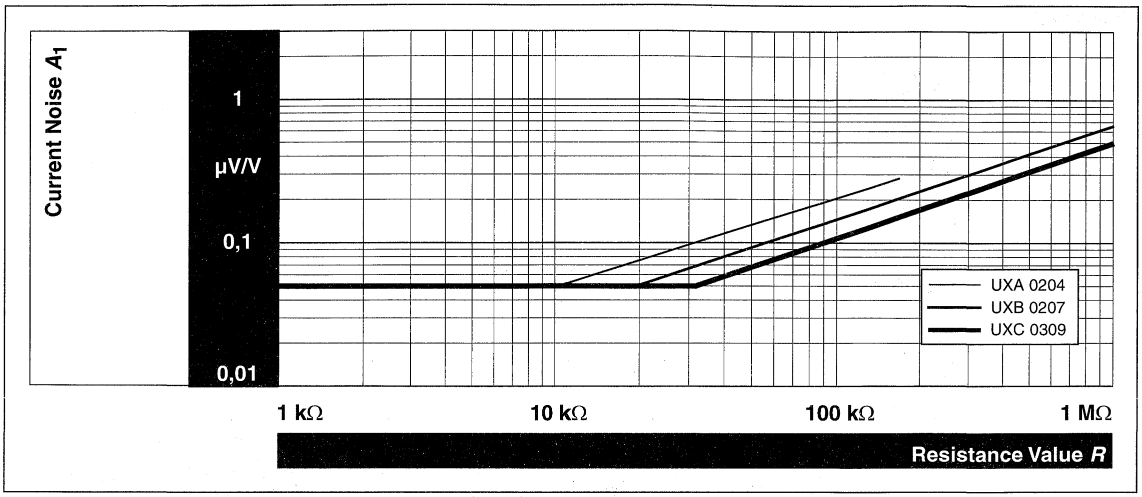
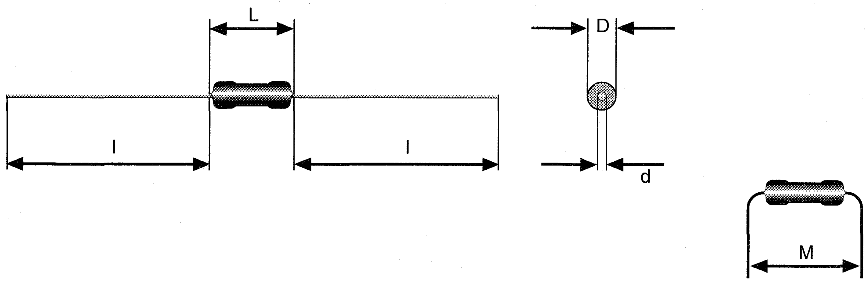


Fig.3 Current noise A_1 in accordance with IEC 60195.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.4 Outlines.

Table 4 Leaded resistor types, mass and relevant physical dimensions; see Fig.4

TYPE	D_{max} (mm)	L_{max} (mm)	d_{nom} (mm)	l_{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
UXC 0309	2,9	8,3	0,7	27,0	10,0	320

SCRIPT MARKING

Table 5 Printed resistance value and letter coding for temperature coefficient and tolerance

RESISTANCE VALUE	TC (ppm/K)	LETTER CODE	TOL. (%)	LETTER CODE
Clear text code for value	±10	B	±0,25	C
	±05	A	±0,1	B
	±02	T	±0,05	A
	±05	A	±0,01	T

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. Table 6 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 1 060 mbar).

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

In Table 6 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.

Table 6 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)		
			Stability for product types:			
			UXA 0204	100 Ω to 100 kΩ	22 Ω to < 100 Ω; > 100 Ω to 221 kΩ	–
			UXB 0207	100 Ω to 250 kΩ	40,2 Ω to < 100 Ω; > 100 Ω to 301 kΩ	10 Ω to < 40,2 Ω; > 301 kΩ to 1 MΩ
			UXC 0309	–	24 Ω to 100 kΩ	10 Ω to < 24 Ω; > 100 kΩ to 1 MΩ
4.5	–	resistance		±0,25%; ±0,1%; ±0,05%; ±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	±(0,05% + 0,01 Ω)	±(0,05% + 0,01 Ω)	±(0,05% + 0,01 Ω)
			85 °C; 1000 h	±(0,02% + 0,01 Ω)	±(0,03% + 0,01 Ω)	±(0,04% + 0,01 Ω)
			85 °C; 8000 h	±(0,04% + 0,01 Ω)	±(0,06% + 0,01 Ω)	±(0,08% + 0,01 Ω)

Ultra precision leaded resistors

UXA 0204; UXB 0207; UXC 0309

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)		
			Stability for product types:			
			UXA 0204	100 Ω to 100 kΩ	22 Ω to < 100 Ω; > 100 Ω to 221 kΩ	–
			UXB 0207	100 Ω to 250 kΩ	40,2 Ω to < 100 Ω; > 100 Ω to 301 kΩ	10 Ω to < 40,2 Ω; > 301 kΩ to 1 MΩ
			UXC 0309	–	24 Ω to 100 kΩ	10 Ω to < 24 Ω; > 100 kΩ to 1 MΩ
4.25.3	–	endurance at upper category temperature	125 °C; 1000 h	±(0,04% + 0,01 Ω)	±(0,06% + 0,01 Ω)	±(0,08% + 0,01 Ω)
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/−3% RH	±(0,04% + 0,01 Ω)	±(0,05% + 0,01 Ω)	±(0,06% + 0,01 Ω)
4.23		climatic sequence:				
4.23.2	2 (Ba)	dry heat	125 °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 to 35 °C			
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	±(0,04% + 0,01 Ω) no visible damage	±(0,05% + 0,01 Ω) no visible damage	±(0,06% + 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	±(0,01% + 0,01 Ω) no visible damage	±(0,01% + 0,01 Ω) no visible damage	±(0,02% + 0,01 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±(0,01% + 0,01 Ω) no visible damage	±(0,01% + 0,01 Ω) no visible damage	±(0,02% + 0,01 Ω) 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 ±5 °C; 10 ±1 s	±(0,01% + 0,01 Ω) no visible damage	±(0,01% + 0,01 Ω) no visible damage	±(0,02% + 0,01 Ω) no visible damage
4.17	20 (Ta)	solderability	+235 °C; 2 s solder bath method	good tinning (≥ 95% covered); no visible damage		

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)		
			Stability for product types:			
			UXA 0204	100 Ω to 100 kΩ	22 Ω to < 100 Ω; > 100 Ω to 221 kΩ	–
			UXB 0207	100 Ω to 250 kΩ	40,2 Ω to < 100 Ω; > 100 Ω to 301 kΩ	10 Ω to < 40,2 Ω; > 301 kΩ to 1 MΩ
			UXC 0309	–	24 Ω to 100 kΩ	10 Ω to < 24 Ω; > 100 kΩ to 1 MΩ
4.22	6 (B4)	vibration	6 h; 10 to 2 000 Hz 1,5 mm or 196 m/s^2	±(0,01% + 0,01 Ω)	±(0,01% + 0,01 Ω)	±(0,02% + 0,01 Ω)
4.16	21 (Ua_1) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	±(0,01% + 0,01 Ω)	±(0,01% + 0,01 Ω)	±(0,02% + 0,01 Ω)
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown		

Ultra precision leaded resistors MPR24

FEATURES

- Ultra high precision resistors
- Ultra high stability
- Ultra low temperature coefficient.

APPLICATIONS

- Test and measurement
- Telecom.

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.

QUICK REFERENCE DATA

DESCRIPTION	MPR24	
CECC size	B	
Resistance range	4,99 Ω to 1 MΩ	
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 °C	155 °C
Max. resistance change for resistance range, $\Delta R/R$ max., after:		
load	±(0,05% + 0,01 Ω)	
climatic tests	±(0,05% + 0,01 Ω)	
soldering	±(0,01% + 0,01 Ω)	
short time overload	±(0,01% + 0,01 Ω)	
Permissible voltage against ambient :		
1 minute	500 V	
continuous	75 V	
Failure rate	$\leq 0,3 \times 10^{-9}$/h	

Ultra precision leaded resistors MPR24

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[(2)]
T.C.[(1)]	TOLERANCE	MPR24
±25 ppm/K	±0,5%	4,99 Ω to 1 MΩ
	±0,25%	4,99 Ω to 1 MΩ
	±0,1%	4,99 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%	4,99 Ω to 1 MΩ
	±0,25%	4,99 Ω to 1 MΩ
	±0,1%	4,99 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%	4,99 Ω to 1 MΩ
	±0,25%	4,99 Ω to 1 MΩ
	±0,1%	4,99 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
±05 ppm/K	±0,5%	4,99 Ω to 1 MΩ
	±0,25%	4,99 Ω to 1 MΩ
	±0,1%	4,99 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.

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2322 14.
- The subsequent 3 digits indicate the resistor type, specification and packaging; see Table 2.
- The remaining 3 digits indicate the resistance value. The number is available upon request and is fixed by the supplier.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2322 14.		
			BANDOLIER(1)	IN BOX	BANDOLIER ON REEL
TYPE	T.C.	TOL.	100 units	1000 units	5000 units
MPR24	±25 ppm/K	±0,5%	1 00...	1 10...	3 10...
		±0,25%	1 20...	1 30...	3 30...
		±0,1%	1 40...	1 50...	3 50...
		±0,05%	1 64...	3 64...	–
		±0,02%	1 74...	3 74...	–
		±0,01%	1 84...	3 84...	–
	±15 ppm/K	±0,5%	1 05...	1 15...	3 15...
		±0,25%	1 25...	1 35...	3 35...
		±0,1%	1 45...	1 55...	3 55...
		±0,05%	1 65...	3 65...	–
		±0,02%	1 75...	3 75...	–
		±0,01%	1 85...	3 85...	–
	±10 ppm/K	±0,5%	1 06...	1 16...	3 16...
		±0,25%	1 26...	1 36...	3 36...
		±0,1%	1 46...	1 56...	3 56...
		±0,05%	1 66...	3 66...	–
		±0,02%	1 76...	3 76...	–
		±0,01%	1 86...	3 86...	–
	±05 ppm/K	±0,5%	1 07...	1 17...	3 17...
		±0,25%	1 27...	1 37...	3 37...
		±0,1%	1 47...	1 57...	3 57...
		±0,05%	1 67...	3 67...	–
		±0,02%	1 77...	3 77...	–
		±0,01%	1 87...	3 87...	–

Note

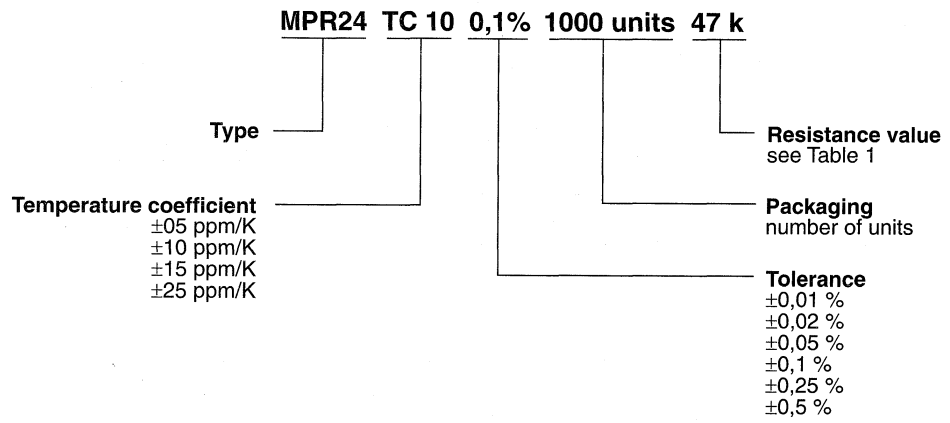
1. Products taped on bandolier are available in 100 units and delivered, according to availability, in tape length, loose in a plastic bag or cardboard box.

Ordering example

The ordering code of an MPR24 resistor with tolerance of ±0,02% and TC ±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.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



Ultra precision leaded resistors MPR24

FUNCTIONAL DESCRIPTION

Derating

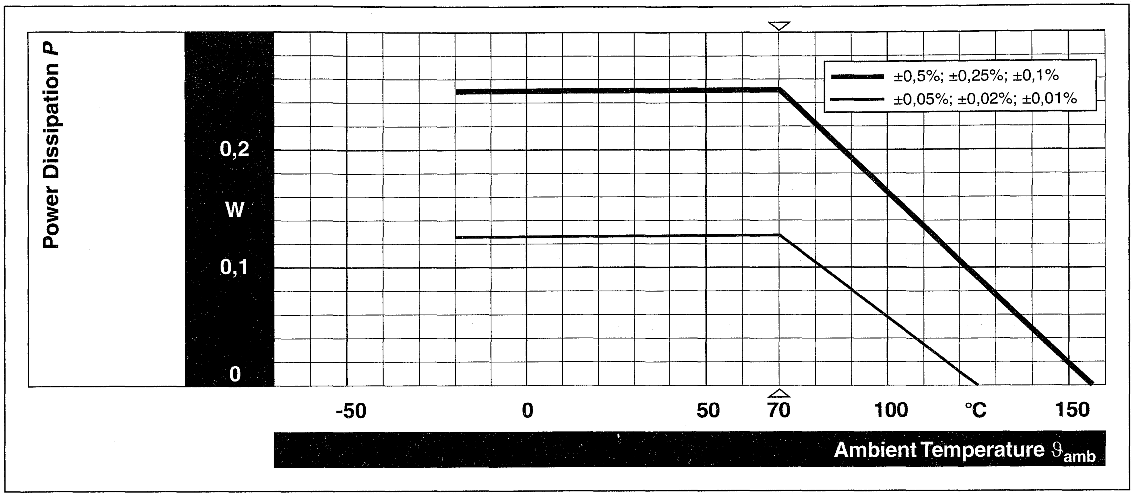
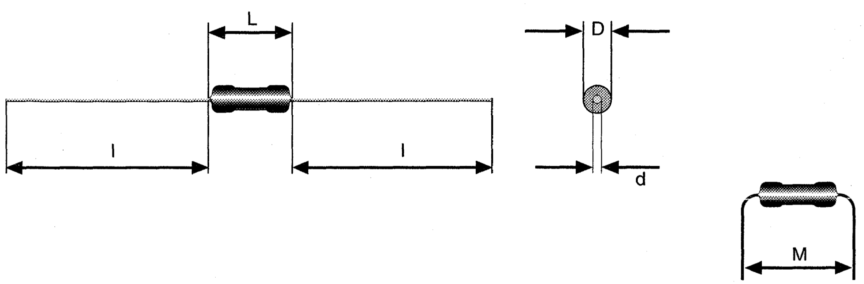


Fig.1 Derating, depending on resistance tolerances.

MECHANICAL DATA

Outlines



For dimensions see Table 3.

Fig.2 Outlines.

Table 3 Leaded resistor types, mass and relevant physical dimensions; see Fig.2

TYPE	D_{max} (mm)	L_{max} (mm)	d_{nom} (mm)	l_{min} (mm)	M_{min} (mm)	MASS (mg)
MPR 24	2.5	6.3	0.6	28.0	7.5	220

SCRIPT MARKING[1]

Table 4 Printed resistance value and letter coding for temperature coefficient and tolerance

RESISTANCE VALUE	TC (ppm/K)	LETTER CODE	TOL. (%)	LETTER CODE
Clear text code for value	±25	E	±0,5	D
	±15	F	±0,25	C
	±10	B	±0,1	B
	±05	A	±0,05	A
	–	–	±0,02	P
	–	–	±0,01	T

Note

1. Resistors of T.C. ±25 ppm/K in combination with tolerances ±0,5%, ±0,25% and ±0,1% are only available with colour coding in accordance with IEC 60062.

Ultra precision leaded resistors MPR24

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. Table 5 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)	
			Stability for product types: MPR24	24 Ω to 100 kΩ	4,99 Ω to < 24 Ω; > 100 kΩ to 1 MΩ
4.5	–	resistance	–	±0,5%; ±0,25%; ±0,1%; ±0,05%; ±0,02%; ±0,01%	±0,5%; ±0,25%; ±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	room temperature; $U = \sqrt{P_{70} \times R}$ or $U = U_{max}$; 1,5 h on; 0,5 h off 70 °C; 2000 h	±(0,05% + 0,01 Ω)	
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±(0,05% + 0,01 Ω)	

Ultra precision leaded resistors MPR24

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)	
			Stability for product types: MPR24	24 Ω to 100 kΩ	4,99 Ω to < 24 Ω; > 100 kΩ to 1 MΩ
4.23		climatic sequence:			
4.23.2	2 (Ba)	dry heat	125 °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 to 35 °C		
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	±(0,05% + 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	±(0,01% + 0,01 Ω) no visible damage	
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±(0,01% + 0,01 Ω) 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 ±5 °C; 10 ±1 s	±(0,01% + 0,01 Ω) no visible damage	
4.17	20 (Ta)	solderability	+235 °C; 2 s solder bath method	good tinning (≥ 95% covered); no visible damage	
4.22	6 (B4)	vibration	6 h; 10 to 2 000 Hz 1,5 mm or 196 m/s^2	±(0,01% + 0,01 Ω); no visible damage	
4.16	21 (Ua_1) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	±(0,01% + 0,01 Ω); no visible damage	
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown	
4.12	–	noise	IEC 60 195: R ≤ 100 kΩ R > 100 kΩ	 max. 0,25 µV/V max. 0,5 µV/V	

Fusible resistors NFR25/25H

FEATURES

- Overload protection without risk of fire
- Wide range of overload currents.

APPLICATIONS

- Audio
- Video.

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 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"*..

QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	NFR25	NFR25H
Resistance range	0.22 Ω to 15 kΩ	
Resistance tolerance and series	±5%; E24 series; note 1	
Maximum dissipation at T_{amb} = 70 °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 × 10^{-6}/K	≤±200 × 10^{-6}/K
4.7 Ω < R ≤ 15 Ω	≤±200 × 10^{-6}/K	≤±100 × 10^{-6}/K
15 Ω < R ≤ 15 kΩ	≤±100 × 10^{-6}/K	≤±100 × 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/R max.: ±1% + 0.05 Ω	
climatic tests	ΔR/R max.: ±1% + 0.05 Ω	
soldering	ΔR/R max.: ±0.25% + 0.05 Ω	

Note

1. 1% tolerance available on request.

ORDERING INFORMATION

Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 23
- The subsequent 7 digits indicate the resistor type and packaging; see Table 1.
- The remaining 3 digits indicate the resistance values:
  - The first 2 digits indicate the resistance value.
  - The last digit indicates the resistance decade in accordance with Table 2.

Table 1 Ordering code indicating 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...

Table 2 Last digit of 12NC

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

ORDERING EXAMPLE

The ordering code for a NFR25 resistor with value 750 Ω, supplied on a bandolier of 1000 units in ammopack is: 2322 205 13751.

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E24 series for resistors with a tolerance of ±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.

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.1.

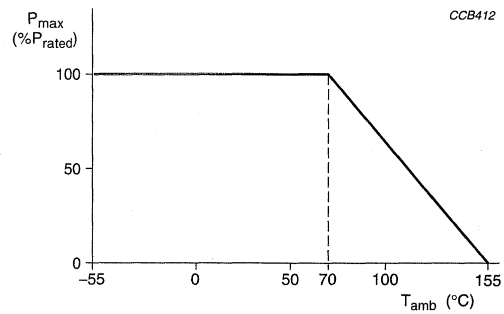
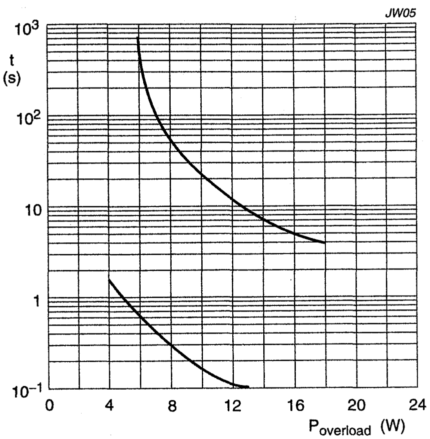


Fig.1 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

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; see Figs 2, 3, 4, 5 and 6.

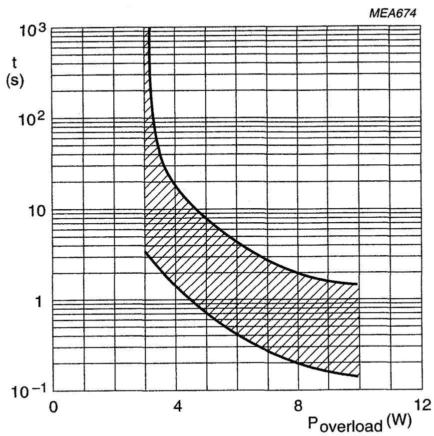
The fusing characteristic is measured under constant voltage.



NFR25

This graph is based on measured data which may deviate according to the application.

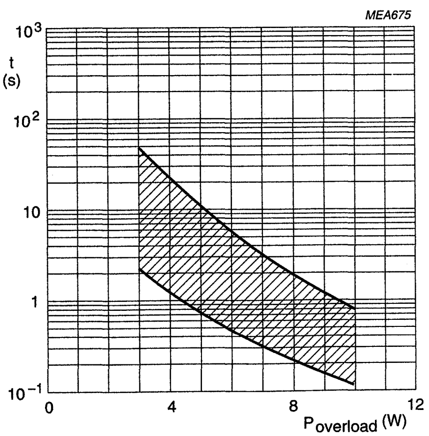
Fig.2 Fusing characteristic: ≤ 1 Ω.



NFR25

This graph is based on measured data which may deviate according to the application.

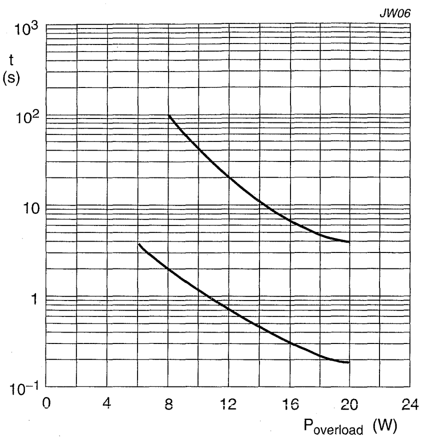
Fig.3 Fusing characteristic: 1 Ω ≤ R ≤ 15 Ω.



NFR25

This graph is based on measured data which may deviate according to the application.

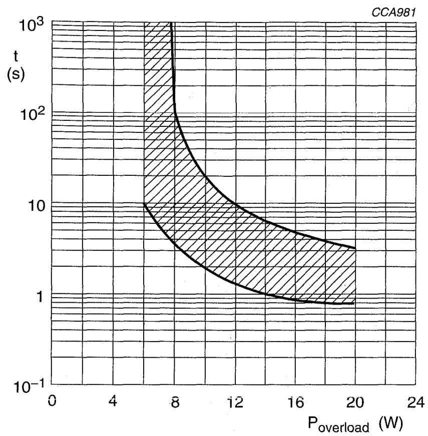
Fig.4 Fusing characteristic: 15 Ω < R ≤ 15 kΩ.



NFR25H

This graph is based on measured data which may deviate according to the application.

Fig.5 Fusing characteristic: ≤ 1 Ω.

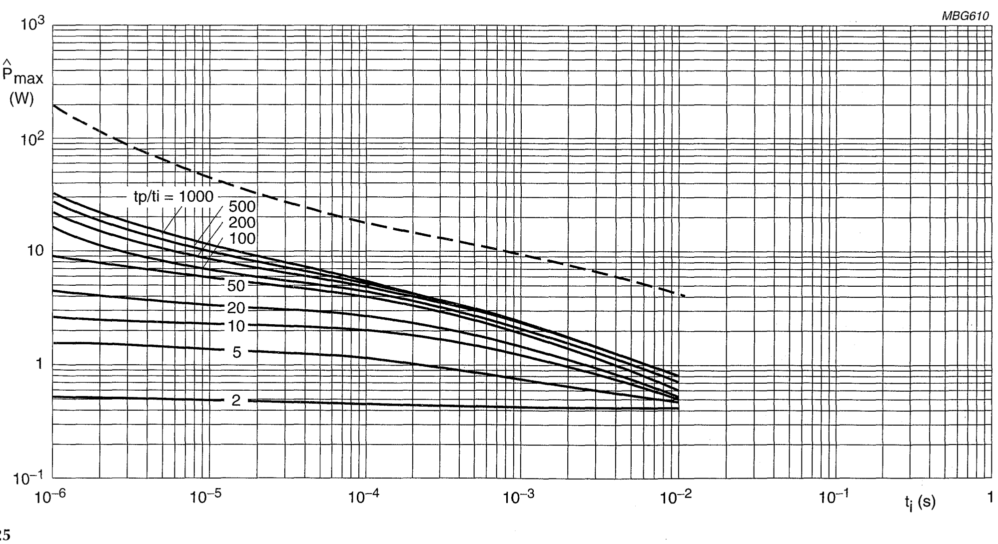


NFR25H

This graph is based on measured data which may deviate according to the application.

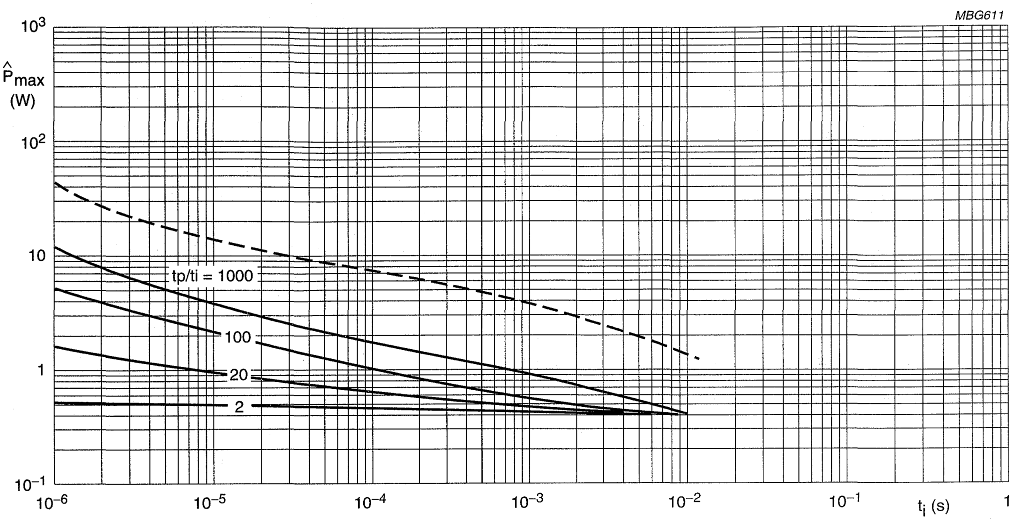
Fig.6 Fusing characteristic.

PULSE LOADING CAPABILITIES



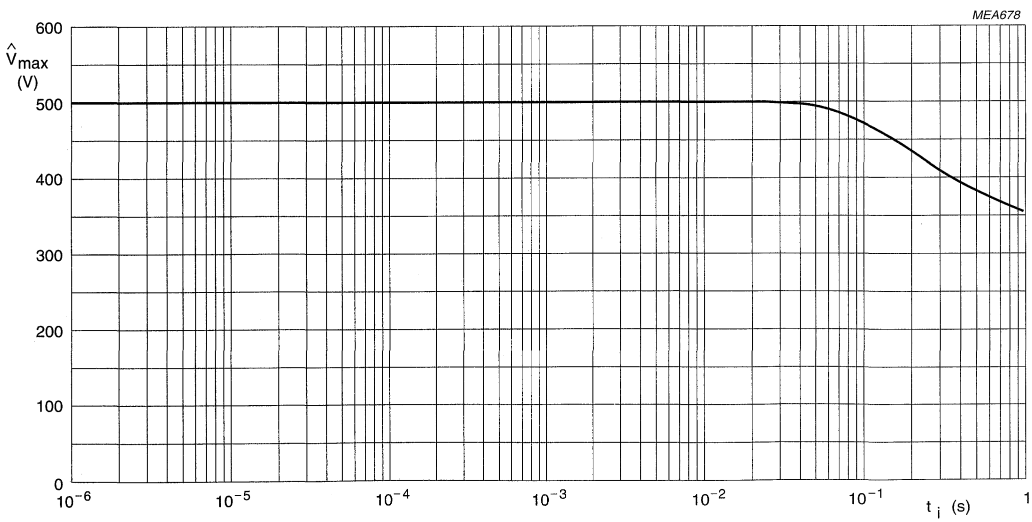
NFR25

Fig.7 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i), 0.22 Ω ≤ R < 15 Ω.



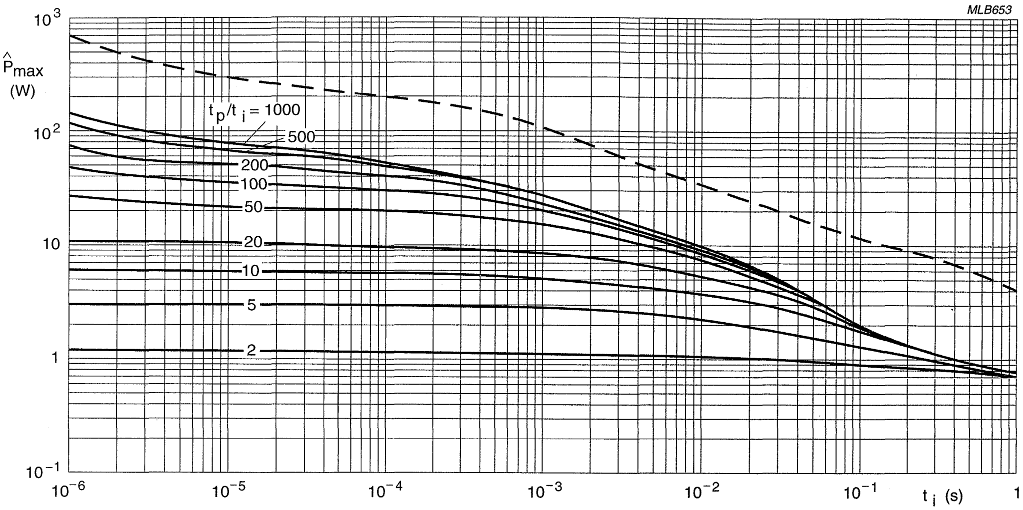
NFR25

Fig.8 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i), 15 Ω < R ≤ 15 kΩ.



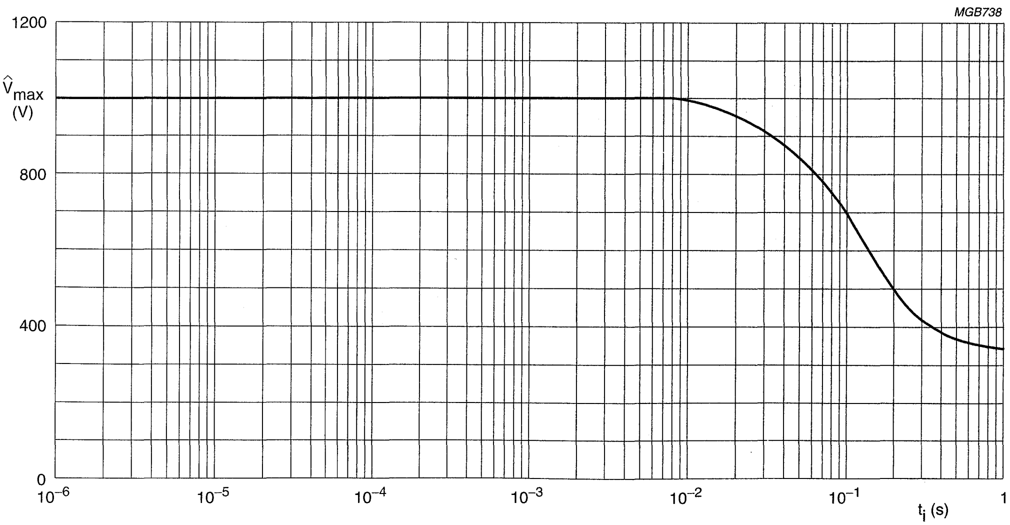
NFR25

Fig.9 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).



NFR25H

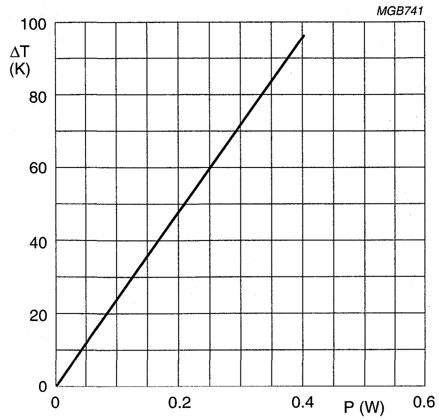
Fig.10 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



NFR25H

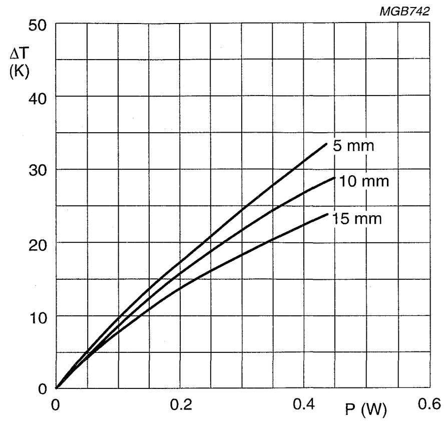
Fig.11 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).

Application information



NFR25

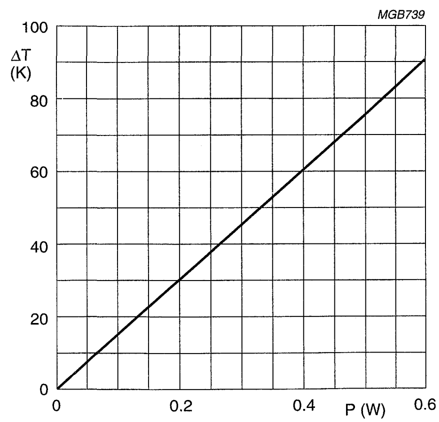
Fig.12 Hot-spot temperature rise (ΔT) as a function of dissipated power.



NFR25

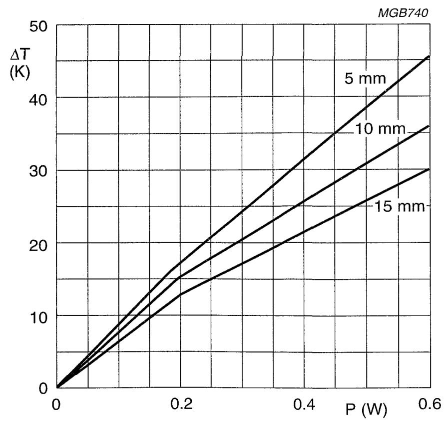
Minimum distance from resistor body to PCB = 1 mm.

Fig.13 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



NFR25H

Fig.14 Hot-spot temperature rise (ΔT) as a function of dissipated power.



NFR25H

Minimum distance from resistor body to PCB = 1 mm.

Fig.15 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.

MECHANICAL DATA

Mass per 100 units

TYPE	MASS (g)
NFR25	25
NFR25H	

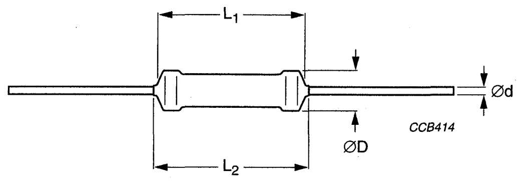
Marking

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

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

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").



For dimensions see Table 3.

Fig.16 Outline.

Table 3 Resistor type and relevant physical dimensions; see Fig.16

TYPE	ØD MAX. (mm)	L_1 MAX. (mm)	L_2 MAX. (mm)	Ød (mm)
NFR25	2.5	6.5	7.5	0.58 ±0.05
NFR25H				

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: **L**ower **C**ategory **T**emperature, **U**pper **C**ategory **T**emperature; 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 Table 4 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.

Table 4 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS NFR25	REQUIREMENTS 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 Table 3	
4.5		resistance	applied voltage (+0/–10%): R < 10 Ω: 0.1 V 10 Ω ≤ R < 100 Ω: 0.3 V 100 Ω ≤ R < 1 kΩ: 1 V 1 kΩ ≤ R < 10 kΩ: 3 V 10 kΩ ≤ R ≤ 15 kΩ: 10 V	$R - R_{nom}$: max. ±5%	
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 6 mm from body	ΔR/R max.: ±0.25% + 0.05 Ω	
4.29	45 (Xa)	component solvent resistance	isopropyl alcohol or H_2O 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	2 × maximum voltage (RMS) during 1 minute; 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 × 10^{-6}	
4.16.3	21 (Ub)	bending half number of samples	load 5 N; 4 × 90°	number of failures <10 × 10^{-6}	
4.16.4	21 (Uc)	torsion other half of samples	3 × 360° in opposite directions	no damage ΔR/R max.: ±0.25% + 0.05 Ω	

Fusible resistors NFR25/25H

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				NFR25	NFR25H
4.20	29 (Eb)	bump	3 × 1500 bumps in 3 directions; 40 g	no damage ΔR/R max.: ±0.25% + 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 hours (3 × 2 hours)	no damage ΔR/R max.: ±0.25% + 0.05 Ω	
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	no visual damage ΔR/R max.: ±0.25% + 0.05 Ω	
4.23		climatic sequence:			
4.23.3	30 (Db)	damp heat (accelerated) 1st cycle			
4.23.6	30 (Db)	damp heat (accelerated) remaining cycles	6 days; 55 °C; 95 to 98% RH	R_{ins} min.: 10^3 MΩ ΔR/R max.: ±1% + 0.05 Ω	
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} max.: 1000 MΩ ΔR/R max.: ±1% + 0.05 Ω	
4.25.1		endurance (at 70 °C)	1000 hours; loaded with P_n or V_{max}; 1.5 hours on and 0.5 hours off	ΔR/R max.: ±1% + 0.05 Ω	
4.25.3		endurance at upper category temperature	1000 hours; no load	ΔR/R max.: ±1% + 0.05 Ω	
4.8.4.2		temperature coefficient	at 20/LCT/20 °C and 20/UCT/20 °C (TC × 10^{-6}/K):		
			0.22 Ω ≤ R ≤ 4.7 Ω	≤±200 × 10^{-6}/K	≤±200 × 10^{-6}/K
			4.7 Ω < R ≤ 15 Ω	≤±200 × 10^{-6}/K	≤±100 × 10^{-6}/K
			15 Ω < R ≤ 15 kΩ	≤±100 × 10^{-6}/K	≤±100 × 10^{-6}/K
4.12		noise	*"IEC publication 60195"*	<0.1 μV/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 hours steam or 16 hours 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 500 V (DC) after 1 minute; metal block method	R_{ins} min.: 10^4 MΩ	
see 2nd amendment to *"IEC 60115-1"*, Jan.'87		pulse load		see Figs 7, 8, 9, 10 and 11	

High ohmic/high voltage resistors VR25

FEATURES

- High pulse loading capability
- Small size.

APPLICATIONS

- Where high resistance, high stability and high reliability at high voltage are required
- High humidity environment
- White goods
- Power supplies.

DESCRIPTION

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"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Resistance range	100 kΩ to 22 MΩ
Resistance tolerance and series:	
100 kΩ to 15 MΩ	±5%: E24 series; ±1%: E24/E96 series
15 MΩ to 22 MΩ	±10%: E12 series
Maximum dissipation at T_{amb} = 70 °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 minute	700 V
Basic specifications	IEC 60115-1B
Climatic category (IEC 60068)	55/155/56
Stability after:	
load (1000 hours)	ΔR/R max.: ±1.5% + 0.1 Ω
accelerated damp heat test (6 days)	ΔR/R max.: ±1.5% + 0.1 Ω
long term damp heat test (56 days)	ΔR/R max.: ±1.5% + 0.1 Ω
Noise	max. 5 µV/V

ORDERING INFORMATION

Table 1 Ordering code indicating resistor type and packaging

TYPE	TAPE WIDTH (mm)	TOL. (%)	ORDERING CODE 2322 241			
			BANDOLIER IN AMMOPACK[(1)]			BANDOLIER ON REEL
			1000 units	2000 units	5000 units	5000 units
VR25	52	±1	8....	–	7....	–
		±5	13...	–	53...	23...
		±10	12...	–	52...	22...
	26	±5	–	43...	–	–
		±10	–	42...	–	–

Note

1. Radial taped version available on request.

Ordering code (12NC)

- The resistors have a 12-digit ordering 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 packaging; see Table 1.
- 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 in accordance with Table 2.

Table 2 Last digit of 12NC

RESISTANCE DECADE	LAST DIGIT
100 to 976 kΩ	4
1 to 9.76 MΩ	5
≥10 MΩ	6

ORDERING EXAMPLE

The ordering code for a VR25, resistor value 7.5 MΩ, 5% tolerance, supplied on a bandolier of 1000 units in ammopack, is: 2322 241 13755.

High ohmic/high voltage resistors VR25

FUNCTIONAL DESCRIPTION

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

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.

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.1.

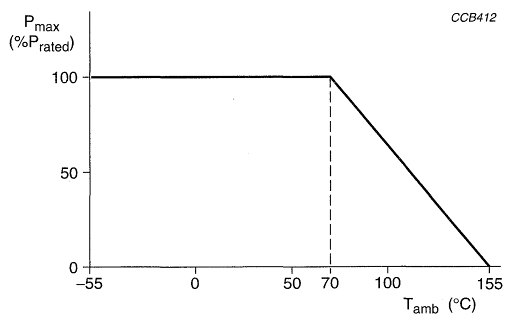


Fig.1 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

PULSE LOADING CAPABILITY

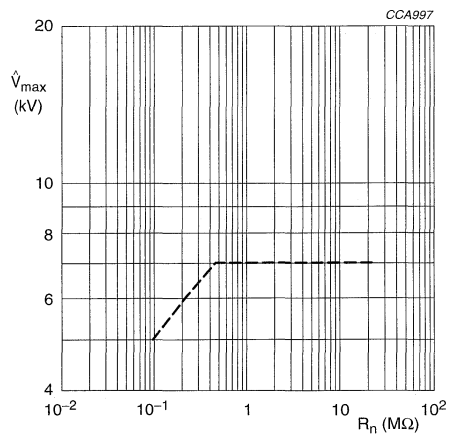


Fig.2 Maximum allowed peak pulse voltage in accordance with *"IEC 60065 chapter 14.1"*; 50 discharges from a 1 nF capacitor charged to $\hat{V}_{max}$; 12 discharges/minute (drift ΔR/R ≤ 1%).

Application information

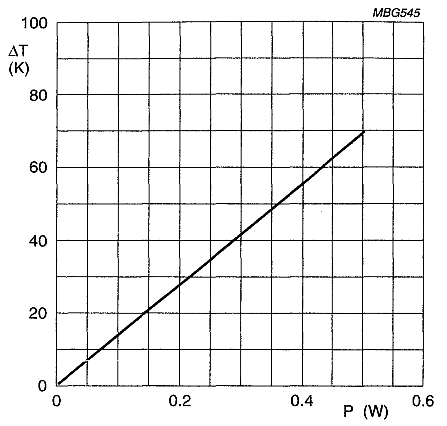


Fig.3 Hot-spot temperature rise (ΔT) as a function of dissipated power.

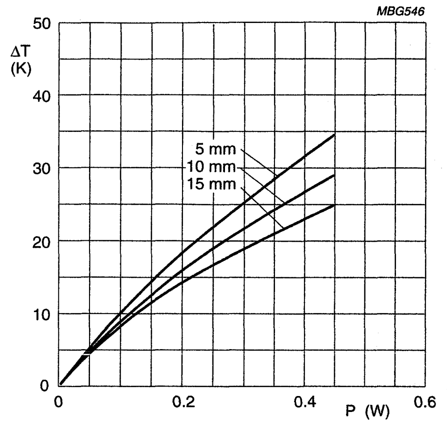


Fig.4 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.

MECHANICAL DATA

Mass per 100 units

TYPE	MASS (g)
VR25	25

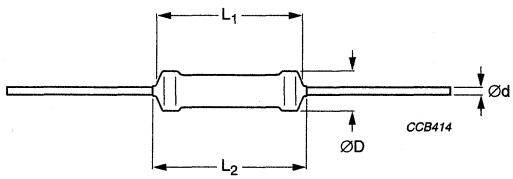
Marking

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

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 (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")*.



For dimensions see Table 3.

Fig.5 Outline.

Table 3 Resistor type and relevant physical dimensions; see Fig.5

TYPE	ØD MAX. (mm)	L_1 MAX. (mm)	L_2 MAX. (mm)	Ød (mm)
VR25	2.5	6.5	7.5	0.58 ±0.05

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: **L**ower **C**ategory **T**emperature, **U**pper **C**ategory **T**emperature; 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 Table 4 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.

Table 4 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	Ø0.6 mm; load 10 N; 10 s	number of failures <10 × 10^{-6}
4.16.3	21 (Ub)	bending half number of samples	Ø0.6 mm; load 5 N; 4 × 90°	number of failures <10 × 10^{-6}
4.16.4	21 (Uc)	torsion other half of samples	3 × 360° in opposite directions	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.17	20 (Ta)	solderability	2 s; 235 °C; flux 600	good tinning; no damage
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 6 mm from body	ΔR/R max.: ±0.5% + 0.05 Ω
4.19	14 (Na)	rapid change of temperature	30 minutes at −55 °C and 30 minutes at +155 °C; 5 cycles	ΔR/R max.: ±0.5% + 0.05 Ω
4.20	29 (Eb)	bump	3 × 1 500 bumps in 3 directions; 40 g	no damage ΔR/R max.: ±0.5% + 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 hours (3 × 2 hours)	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	16 hours; 155 °C	
4.23.3	30 (Db)	damp heat (accelerated) 1st cycle	24 hours; 55 °C; 90 to 100% RH	
4.23.4	1 (Aa)	cold	2 hours; −55 °C	
4.23.5	13 (M)	low air pressure	2 hours; 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/R max.: ±1.5% + 0.1 Ω

High ohmic/high voltage resistors VR25

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/R max.: ±1.5% + 0.1 Ω
4.25.1		endurance	1000 hours at 70 °C; P_n or V_{max}	ΔR/R max.: ±1.5% + 0.1 Ω
4.8.4		temperature coefficient	between −55 °C and +155 °C (TC × 10^{-6}/K)	≤±200
4.7		voltage proof on insulation	700 V (RMS) during 1 minute; 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 minute; V-block method	R_{ins} min.: 10^4 MΩ
4.13		short time overload	room temperature; dissipation 6.25 × P_n (voltage not more than 2 × limiting voltage); 10 cycles; 5 s on and 45 s off	ΔR/R max.: ±0.5% + 0.05 Ω
4.26		active flammability "Cheese-cloth test"	steps of: 5/10/16/25/40 × P_n (RMS) duration 5 minutes	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/high voltage resistors VR37

FEATURES

- These resistors meet the safety requirements of:
  "UL1676" (range 510 kΩ to 11 MΩ)
  "IEC 60065 5th edition"
  "EN60065" (IEC 60 065 6th edition)
  "BS60065" (U.K.)
  "VDE 0860" (Germany)
  "CCEE" (China)
- High pulse loading capability
- Small size.

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.

DESCRIPTION

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"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Resistance range	100 kΩ to 33 MΩ; note 1
Resistance tolerance and series	±1%: E24/E96 series; ±5%: E24 series
Maximum dissipation at T_{amb} = 70 °C	0.5 W
Thermal resistance, R_{th}	120 K/W
Temperature coefficient	$\leq \pm 200 \times 10^{-6}$/K
Maximum permissible voltage:	
DC	3500 V
RMS	2500 V
Dielectric withstanding voltage of the insulation for 1 minute	700 V
Basic specifications	IEC 60115-1B
Safety requirements	UL1676 (510 kΩ to 11 MΩ); EN60065; BS60065; VDE 0860; NFC 92-130
Climatic category (IEC 60068)	55/155/56
Stability after:	
load (1000 hours)	ΔR/R max.: ±1.5% + 0.1 Ω; typ. 0.5%
accelerated damp heat test (6 days)	ΔR/R max.: ±1.5% + 0.1 Ω; typ. 0.5%
long term damp heat test (56 days)	ΔR/R max.: ±1.5% + 0.1 Ω; typ. 0.5%
Noise	max. 2.5 μV/V; typ. 0.5

Note

1. Values up to 100 MΩ are available upon request.

ORDERING INFORMATION

Table 1 Ordering code indicating 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....	–
		±5	13...	23...

Ordering code (12NC)

- The resistors have a 12-digit ordering 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; see Table 1.
- 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 in accordance with Table 2.

Table 2 Last digit of 12NC

RESISTANCE DECADE	LAST DIGIT
100 to 976 kΩ	4
1 to 9.76 MΩ	5
≥10 MΩ	6

ORDERING EXAMPLE

The ordering code for a VR37, resistor value 7.5 MΩ, 5% tolerance, supplied on a bandolier of 1000 units in ammopack, is: 2322 242 13755.

High ohmic/high voltage resistors VR37

FUNCTIONAL DESCRIPTION

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

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.

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.1.

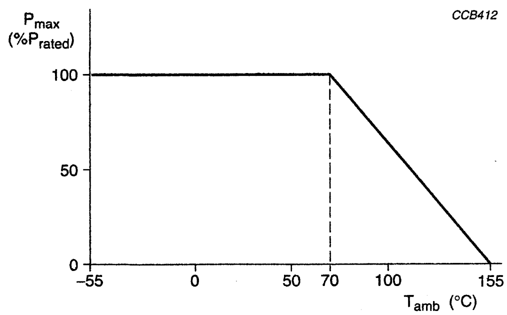


Fig.1 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

PULSE LOADING CAPABILITY

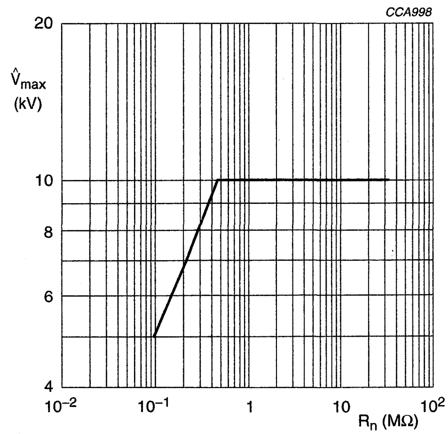


Fig.2 Maximum allowed peak pulse voltage in accordance with *"IEC 60065 chapter 14.1"*; 50 discharges from a 1 nF capacitor charged to $\hat{V}_{max}$; 12 discharges/minute (drift $\Delta R/R \leq 1\%$).

Application information

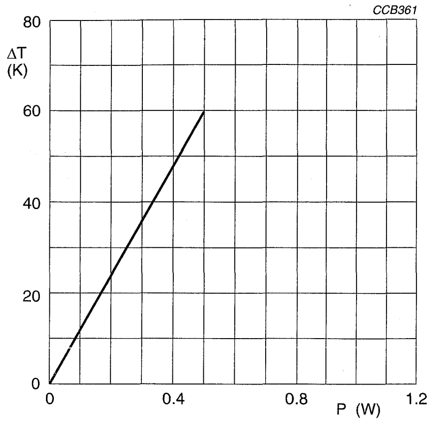


Fig.3 Hot-spot temperature rise (ΔT) as a function of dissipated power.

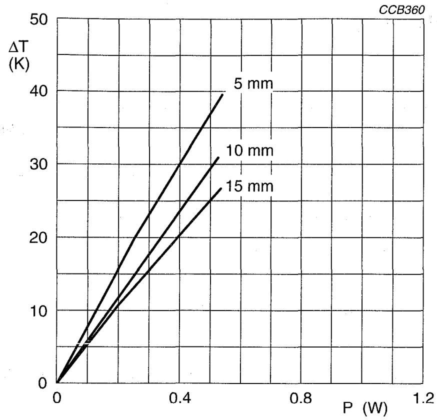


Fig.4 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.

MECHANICAL DATA

Mass per 100 units

TYPE	MASS (g)
VR37	48

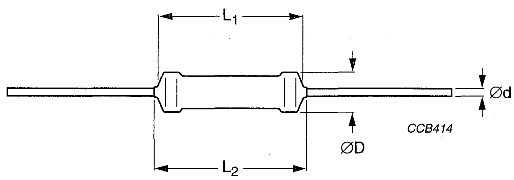
Marking

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

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 (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")*.



For dimensions see Table 3.

Fig.5 Outline.

Table 3 Resistor type and relevant physical dimensions; see Fig.5

TYPE	ØD MAX. (mm)	L_1 MAX. (mm)	L_2 MAX. (mm)	Ød (mm)
VR37	4.0	9.0	10.0	0.7 ±0.03

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: **L**ower **C**ategory **T**emperature, **U**pper **C**ategory **T**emperature; 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 Table 4 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.

Table 4 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	Ø0.7 mm; load 10 N; 10 s	number of failures <10 × 10^{-6}
4.16.3	21 (Ub)	bending half number of samples	Ø0.7 mm; load 5 N; 4 × 90°	number of failures <10 × 10^{-6}
4.16.4	21 (Uc)	torsion other half of samples	3 × 360° in opposite directions	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.17	20 (Ta)	solderability	2 s; 235 °C; flux 600	good tinning; no damage
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 6 mm from body	ΔR/R max.: ±0.5% + 0.05 Ω
4.19	14 (Na)	rapid change of temperature	30 minutes at −55 °C and 30 minutes at +155 °C; 5 cycles	ΔR/R max.: ±0.5% + 0.05 Ω
4.20	29 (Eb)	bump	3 × 1 500 bumps in 3 directions; 40 g	no damage ΔR/R max.: ±0.5% + 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 hours (3 × 2 hours)	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	16 hours; 155 °C	
4.23.3	30 (Db)	damp heat (accelerated) 1st cycle	24 hours; 55 °C; 90 to 100% RH	
4.23.4	1 (Aa)	cold	2 hours; −55 °C	
4.23.5	13 (M)	low air pressure	2 hours; 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/R max.: ±1.5% + 0.1 Ω
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/R max.: ±1.5% + 0.1 Ω

High ohmic/high voltage resistors VR37

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.25.1		endurance	1000 hours at 70 °C; P_n or V_{max}	ΔR/R max.: ±1.5% + 0.1 Ω
4.8.4		temperature coefficient	between −55 °C and +155 °C (TC × 10^{-6}/K)	≤±200
4.7		voltage proof on insulation	700 V (RMS) during 1 minute; V-block method	no breakdown
4.12		noise	*"IEC publication 60195"*	max. 2.5 μV/V
4.6.1.1		insulation resistance	500 V (DC) during 1 minute; V-block method	R_{ins} min.: 10^4 MΩ
4.13		short time overload	room temperature; dissipation 6.25 × P_n (voltage not more than 2 × limiting voltage); 10 cycles; 5 s on and 45 s off	ΔR/R max.: ±0.5% + 0.05 Ω

High ohmic/high voltage resistors VR68

FEATURES

- These resistors meet the safety requirements of:
  "UL1676" (range 510 kΩ to 11 MΩ)
  "IEC 60065 5th edition"
  "EN60065" (*IEC 60 065 6th edition)*
  "BS60065" (U.K.)
  "VDE 0860" (Germany)
  "CCEE" (China)
- High pulse loading capability
- Small size.

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.

DESCRIPTION

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"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Resistance range	100 kΩ to 68 MΩ; note 1
Resistance tolerance and series	±1%: E24/E96 series; ±5%; E24 series
Maximum dissipation at T_{amb} = 70 °C	1 W
Thermal resistance, R_{th}	70 K/W
Temperature coefficient	≤±200 × 10^{-6}/K
Maximum permissible voltage:	
DC	10000 V
RMS	7000 V
Dielectric withstanding voltage of the insulation for 1 minute	700 V
Basic specifications	IEC 60115-1B
Safety requirements	UL1676 (510 kΩ to 11 MΩ); EN60065; BS60065; VDE 0860; NFC 92-130
Climatic category (IEC 60068)	55/155/56
Stability after:	
load (1000 hours)	ΔR/R max.: ±1.5% + 0.1 Ω; typ. 1%
accelerated damp heat test (6 days)	ΔR/R max.: ±1.5% + 0.1 Ω; typ. 1%
long term damp heat test (56 days)	ΔR/R max.: ±1.5% + 0.1 Ω; typ. 0.5%
Noise	max. 2.5 µV/V; typ. 0.5

Note

1. Values up to 220 MΩ are available upon request.

High ohmic/high voltage resistors VR68

ORDERING INFORMATION

Table 1 Ordering code indicating resistor type and packaging

TYPE	TAPE WIDTH (mm)	TOL. (%)	ORDERING CODE 2322 244 ..... BANDOLIER IN AMMOPACK 500 units
VR68	66.7	±1	8....
		±5	13...

Ordering code (12NC)

- The resistors have a 12-digit ordering 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 packaging; see Table 1.
- 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 in accordance with Table 2.

Table 2 Last digit of 12NC

RESISTANCE DECADE	LAST DIGIT
100 to 976 kΩ	4
1 to 9.76 MΩ	5
≥10 MΩ	6

ORDERING EXAMPLE

The ordering code for a VR68, resistor value 7.5 MΩ, 5% tolerance, supplied on a bandolier of 500 units in ammopack, is: 2322 244 13755.

FUNCTIONAL DESCRIPTION

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	10000	7000	1.0

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.

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.1.

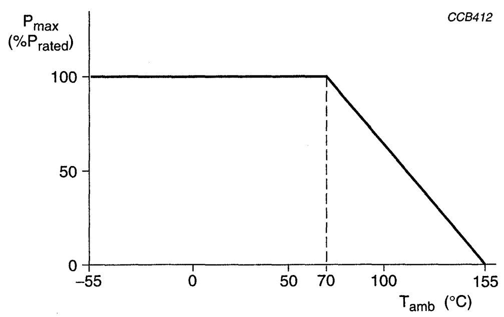


Fig.1 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

PULSE LOADING CAPABILITY

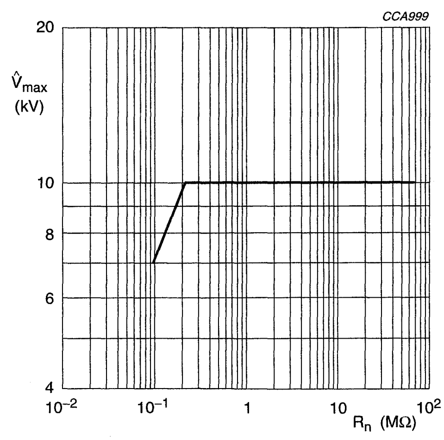


Fig.2 Maximum allowed peak pulse voltage in accordance with *"IEC 60065 chapter 14.1"*; 50 discharges from a 1 nF capacitor charged to $\hat{V}_{max}$; 12 discharges/minute (drift ΔR/R ≤ 1%).

High ohmic/high voltage resistors VR68

Application information

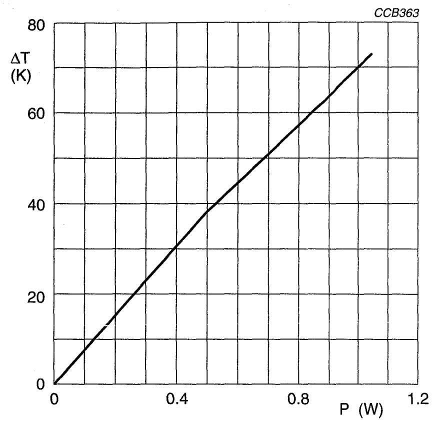


Fig.3 Hot-spot temperature rise (ΔT) as a function of dissipated power.

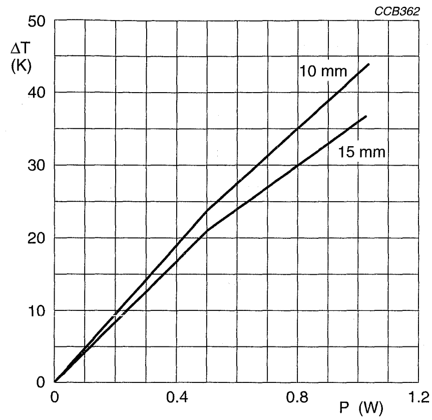


Fig.4 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.

MECHANICAL DATA

Mass per 100 units

TYPE	MASS (g)
VR68	148

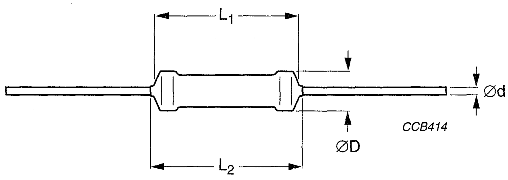
Marking

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

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 (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")*.



For dimensions see Table 3.

Fig.5 Outline.

Table 3 Resistor type and relevant physical dimensions; see Fig.5

TYPE	ØD MAX. (mm)	L_1 MAX. (mm)	L_2 MAX. (mm)	Ød (mm)
VR68	6.8	18.0	19.0	0.8 ±0.03

High ohmic/high voltage resistors VR68

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: **L**ower **C**ategory **T**emperature, **U**pper **C**ategory **T**emperature; 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 Table 4 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.

Table 4 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	∅0.8 mm; load 10 N; 10 s	number of failures <10 × 10^{-6}
4.16.3	21 (Ub)	bending half number of samples	∅0.8 mm; load 5 N; 4 × 90°	number of failures <10 × 10^{-6}
4.16.4	21 (Uc)	torsion other half of samples	3 × 360° in opposite directions	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.17	20 (Ta)	solderability	2 s; 235 °C; flux 600	good tinning; no damage
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 6 mm from body	ΔR/R max.: ±0.5% + 0.05 Ω
4.19	14 (Na)	rapid change of temperature	30 minutes at −55 °C and 30 minutes at +155 °C; 5 cycles	ΔR/R max.: ±0.5% + 0.05 Ω
4.20	29 (Eb)	bump	3 × 1 500 bumps in 3 directions; 40 g	no damage ΔR/R max.: ±0.5% + 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 hours (3 × 2 hours)	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	16 hours; 155 °C	
4.23.3	30 (Db)	damp heat (accelerated) 1st cycle	24 hours; 55 °C; 90 to 100% RH	
4.23.4	1 (Aa)	cold	2 hours; −55 °C	
4.23.5	13 (M)	low air pressure	2 hours; 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/R max.: ±1.5% + 0.1 Ω

High ohmic/high voltage resistors VR68

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)	$\Delta R/R$ max.: ±1.5% + 0.1 Ω
4.25.1		endurance	1000 hours at 70 °C; P_n or V_{max}	$\Delta R/R$ max.: ±1.5% + 0.1 Ω
4.8.4		temperature coefficient	between −55 °C and +155 °C ($TC \times 10^{-6}/K$)	≤ ±200
4.7		voltage proof on insulation	700 V (RMS) during 1 minute; V-block method	no breakdown
4.12		noise	*"IEC publication 60195"*	max. 2.5 µV/V
4.6.1.1		insulation resistance	500 V (DC) during 1 minute; V-block method	R_{ins} min.: 10^4 MΩ
4.13		short time overload	room temperature; dissipation 6.25 × P_n (voltage not more than 2 × limiting voltage; 10000 V max.); 10 cycles; 5 s on and 45 s off	$\Delta R/R$ max.: ±0.5% + 0.05 Ω

Low ohmic surge resistor LSR37

FEATURES

- High pulse-loading capability (flashes)
- Good replacement for carbon-composite resistors.

APPLICATIONS

- Application for overload and high voltage pulse hazard circuits (TV-sets, monitors).

DESCRIPTION

A metal glazed film is deposited on a high grade ceramic body. After that caps are applied to the rods and 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"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Resistance range	220 Ω to 910 Ω	1 kΩ to 10 kΩ
Resistance tolerance and series	±10%; ±20%; E12 series	
Maximum dissipation at T_{amb} = 70 °C	0.5 W	
Thermal resistance, R_{th}	120 K/W	
Temperature coefficient	0 to +600 × 10^{-6}/K	−600 to +200 × 10^{-6}/K
Voltage coefficient	0 to +350 × 10^{-6}/K	±50 × 10^{-6}/V
Maximum permissible voltage	$V = \sqrt{P_n \times R}$	
Dielectric withstanding voltage of the insulation for 1 minute	700 V	
Basic specifications	IEC 60115-1B	
Climatic category (IEC 60068)	55/155/56	
Stability after:		
load (1000 hours)	ΔR/R max.: ±3% + 0.1 Ω	
climatic test	ΔR/R max.: ±3% + 0.1 Ω	
soldering	ΔR/R max.: ±1% + 0.1 Ω	
High voltage test for R-value > 3.3 kΩ, 10 kV; 1 nF; 50 × 12/minutes	ΔR/R max.: ±20% (typical value ±10%)	
ESD contact discharge 12 kV; 100 pulses	ΔR/R max.: ±20% (typical value: ±10%)	

ORDERING INFORMATION

Ordering code (12NC)

- The resistors have a 12-digit ordering code staring with 2322 245
- The subsequent 2 digits indicate the resistor type and packaging; see Table 1.
- The remaining digits indicate the resistance value:
  - The first 2 digits indicate the resistance value.
  - The last digit indicates the resistance decade in accordance with Table 2.

Table 1 Ordering code as function of tolerance and packaging

TYPE	TOLERANCE (%)	ORDERING CODE 2322 245	
		1000 units IN AMMOPACK	5000 units ON REEL
LSR37	±10	12...	22...
	±20	11...	21...

Table 2 Last digit of 12NC

RESISTANCE DECADE	LAST DIGIT
220 to 910 Ω	1
1 to 9.1 kΩ	2
10 kΩ	3

ORDERING EXAMPLE

The ordering code for a LSR37, resistor value 1.5 kW, 10% tolerance, supplied on a bandolier of 1000 units in ammopack, is: 2322 245 12152.

Low ohmic surge resistor LSR37

FUNCTIONAL DESCRIPTION

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 kW at P_n = 0.5 W is only 70.7 V.

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

Limiting values

TYPE	LIMITING VOLTAGE[1] (V)	LIMITING POWER (W)
LSR37	$V = \sqrt{P_n \times R}$	0.5

Note

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

DERATING

The power that the resistor can dissipate depends on the operating temperature; see **Fig.1**.

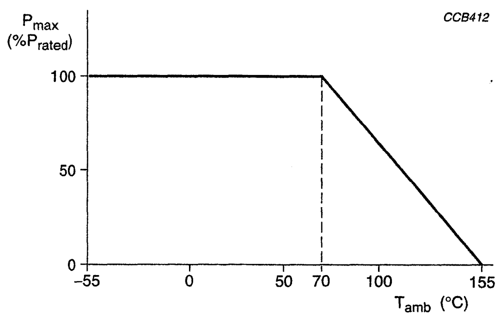


Fig.1 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

PULSE LOADING CAPABILITY

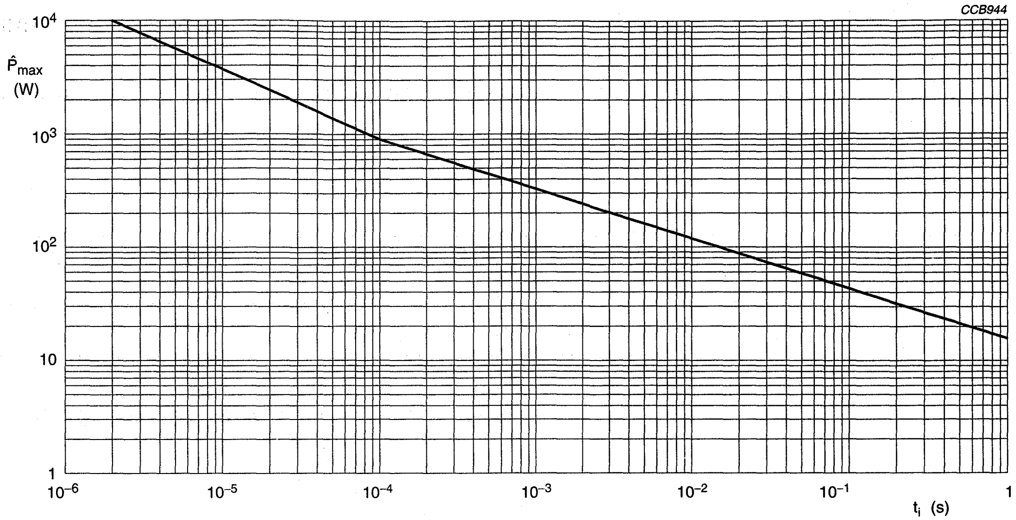


Fig.2 Pulse on a regular basis; maximum permissible peak pulse power $\hat{P}_{max}$ as a function of pulse duration (t_i) for single pulse condition.

Low ohmic surge resistor LSR37

Application information

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 (15.0 mm).

For temperature rise at soldering place see Fig.4.

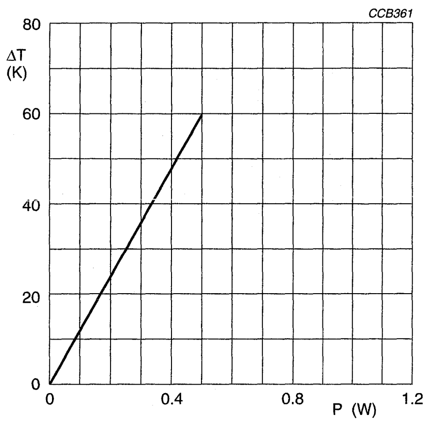


Fig.3 Hot-spot temperature rise (ΔT) as a function of dissipated power.

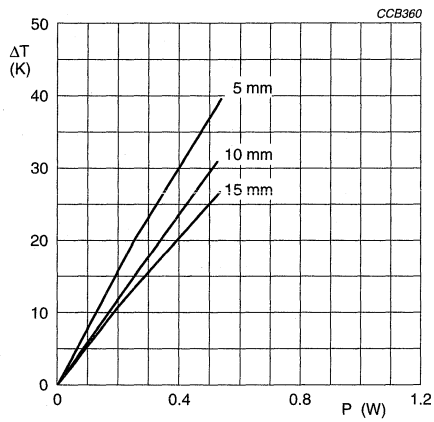


Fig.4 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.

MECHANICAL DATA

Mass per 100 units

TYPE	MASS (g)
LSR37	48

Marking

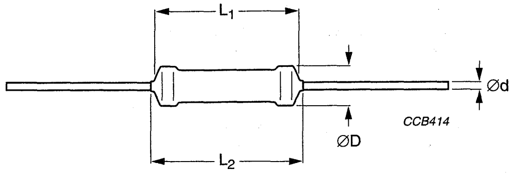
The nominal resistance and tolerance are marked on the resistor using coloured bands in accordance with IEC publication 60062 *"Colour codes for fixed resistors"*.

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% and yellow is used instead of gold for 5% because metal particles in the lacquer could affect high-voltage properties.

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")*.



For dimensions see Table 3.

Fig.5 Outline.

Table 3 Resistor type and relevant physical dimensions; see Fig.5

TYPE	ØD MAX. (mm)	L_1 MAX. (mm)	L_2 MAX. (mm)	Ød (mm)
LSR37	4.0	9.0	10.0	0.7 ±0.03

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: **L**ower **C**ategory **T**emperature, **U**pper **C**ategory **T**emperature; 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 Table 4 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.

Table 4 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	Ø0.7 mm; load 10 N; 10 s	number of failures <10 × 10^{-6}
4.16.3	21 (Ub)	bending half number of samples	Ø0.7 mm; load 5 N; 4 × 90°	number of failures <10 × 10^{-6}
4.16.4	21 (Uc)	torsion other half of samples	3 × 360° in opposite directions	no damage ΔR/R max.: ±1.0% + 0.10 Ω
4.17	20 (Ta)	solderability	2 s; 235 °C; flux 600	good tinning; no damage
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 6 mm from body	ΔR/R max.: ±1.0% + 0.10 Ω
4.19	14 (Na)	rapid change of temperature	30 minutes at −55 °C and 30 minutes at +155 °C; 5 cycles	ΔR/R max.: ±1.0% + 0.10 Ω
4.20	29 (Eb)	bump	3 × 1 500 bumps in 3 directions; 40 g	no damage ΔR/R max.: ±1.0% + 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 hours (3 × 2 hours)	no damage ΔR/R max.: ±1.0% + 0.10 Ω
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	16 hours; 155 °C	
4.23.3	30 (Db)	damp heat (accelerated) 1st cycle	24 hours; 55 °C; 90 to 100% RH	
4.23.4	1 (Aa)	cold	2 hours; −55 °C	
4.23.5	13 (M)	low air pressure	2 hours; 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/R max.: ±3.0% + 0.1 Ω
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/R max.: ±3.0% + 0.1 Ω

Low ohmic surge resistor LSR37

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.25.1		endurance	1000 hours at 70 °C; P_n or V_{max}	ΔR/R max.: ±3.0% + 0.1 Ω
4.8.4		temperature coefficient	220 Ω to 910 Ω	0 to +600 × 10^{-6}/K
			1 kΩ to 10 kΩ	−600 to +200 × 10^{-6}/K
4.7		voltage proof on insulation	700 V (RMS) during 1 minute; V-block method	no breakdown
4.6.1.1		insulation resistance	500 V (DC) during 1 minute; V-block method	R_{ins} min.: 10^4 MΩ
4.13		short time overload	room temperature; dissipation 6.25 × P_n; 10 cycles; 5 s on and 45 s off	ΔR/R max.: ±2.5% + 0.10 Ω
		high voltage pulse 10 kV; 1 nF; 50 × 12/min	for R_n > 3.3 kΩ	ΔR/R max.: ±20% (typical value ±10%)
		12 kV ESD test; 100 pulses	ESD contact discharge	ΔR/R max.: ±20% (typical value: ±10%)
4.26		active flammability "Cheese-cloth test"	5 × P_n (RMS) duration 5 minutes	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 pulse load leaded resistor CBB 0207

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
- Sizes:
  - DIN: 0207
  - CECC: B

APPLICATIONS

- Automotive
- Telecommunication
- Industrial equipment.

DESCRIPTION

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.

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% Al_2O_3) 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**.

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The resistors are tested in accordance with **CECC 40 101-806** which refers to **EN 140 000 (IEC 60 115-1)** and **EN 140 100 (IEC 60 115-2).**

BCcomponents BEYSCHLAG has achieved **"Approval of Manufacturer"** in accordance with **EN 100 114-1**.

High pulse load leaded resistor CBB 0207

QUICK REFERENCE DATA

DESCRIPTION	CBB 0207	
CECC size	B	
Resistance range	10 Ω to 1,5 MΩ	
Resistance tolerance	±2%	
Temperature coefficient	refer to Fig.9	
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	
1 000 h	±1%	±2%
8 000 h	+3%/–1%	+5%/–2%
Specified lifetime	225000 h	8000 h
Permissible voltage against ambient:		
1 minute	500 V	
continuous	75 V	
Failure rate	$\leq 0,3 \times 10^{-9}$/h	

Table 1 Tolerance and resistance range

TOLERANCE	RESISTANCE VALUE[1] CBB 0207
±2%	10 Ω to 1,5 MΩ

Note

1. Resistance value to be selected from E24 series.

High pulse load leaded resistor CBB 0207

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION		ORDERING CODE 2312	
		BANDOLIER IN BOX	
TYPE	TOL.	C1 1 000 units	CT 5 000 units
CBB 0207	±2%	950 2....	**955 2....**

Resistance ranges printed in bold are preferred T.C. / tolerance combinations with optimized availability.

Table 3 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

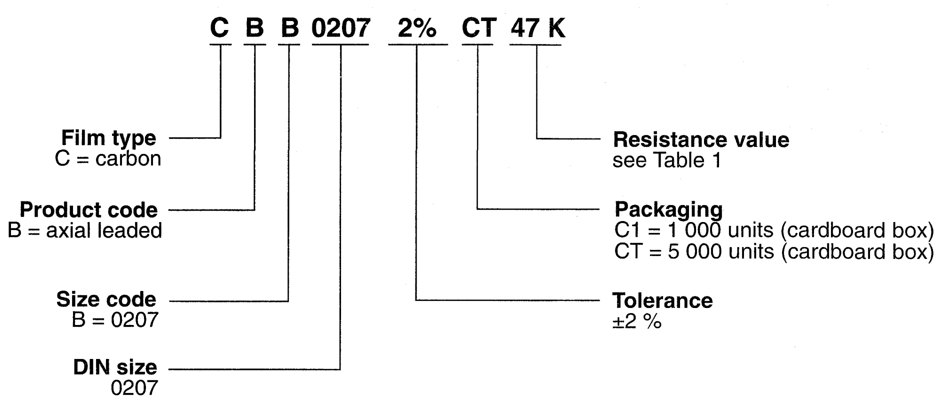
ORDERING EXAMPLE

The ordering code of a CBB 0207 resistor, value 47 kΩ with ±2% tolerance, supplied on bandolier in a box of 5000 units is: 2312 955 24703.

High pulse load leaded resistor CBB 0207

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



For CBB 0207 the temperature coefficient is not identified in the ordering code.

High pulse load leaded resistor CBB 0207

FUNCTIONAL DESCRIPTION

Derating

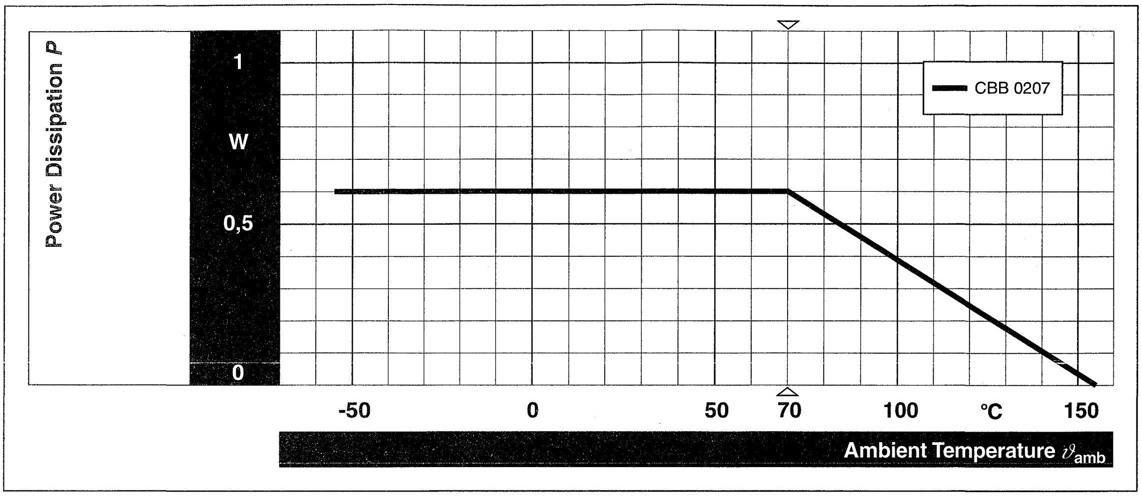


Fig.1 Derating, standard operation.

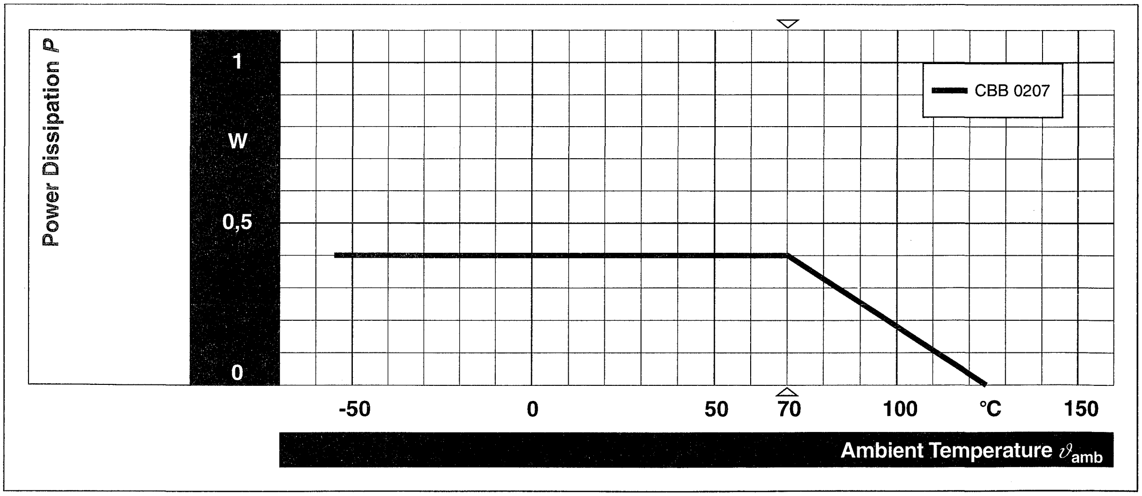


Fig.2 Derating, long term operation.

Temperature rise

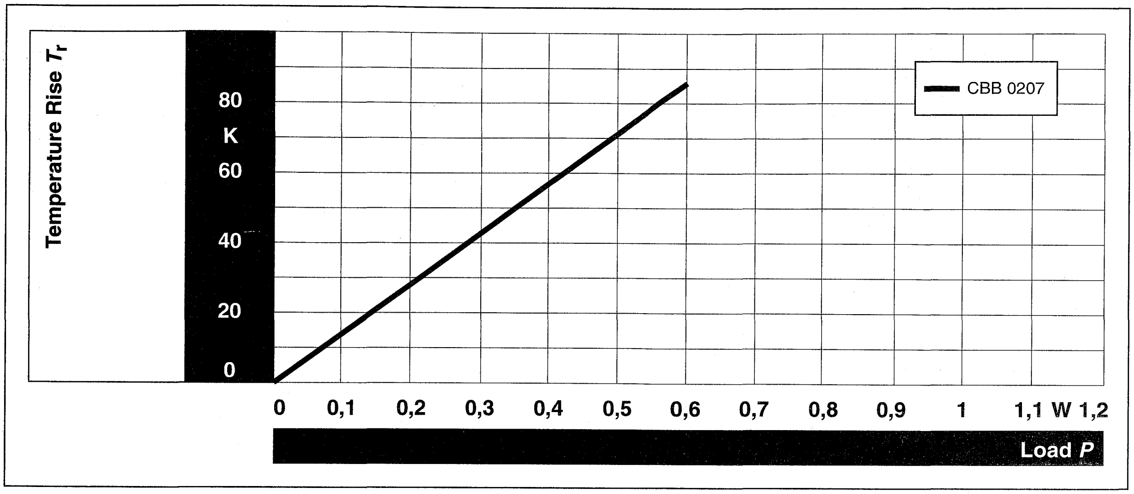


Fig.3 Temperature rise.

Single pulse

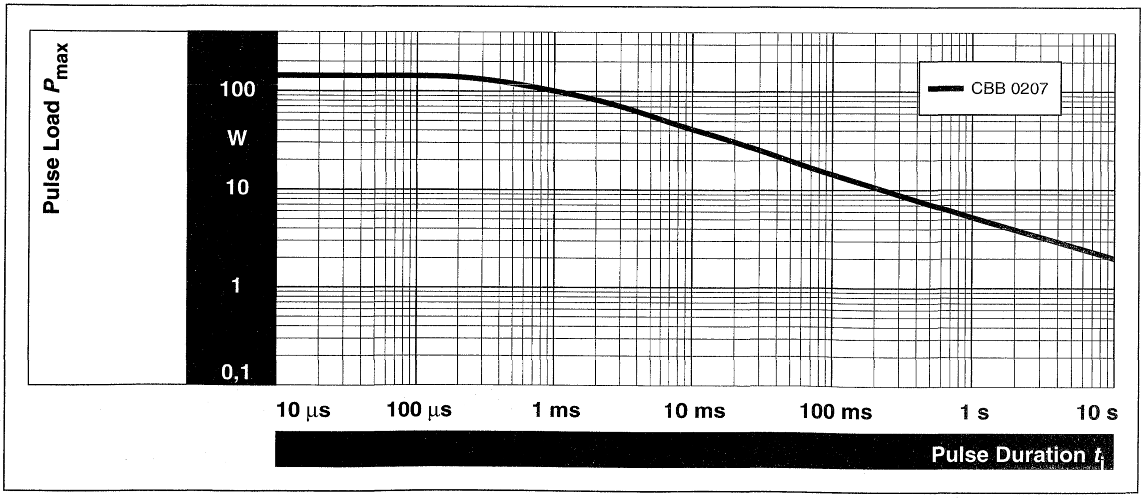


Fig.4 Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation.

High pulse load leaded resistor CBB 0207

Continuous pulses

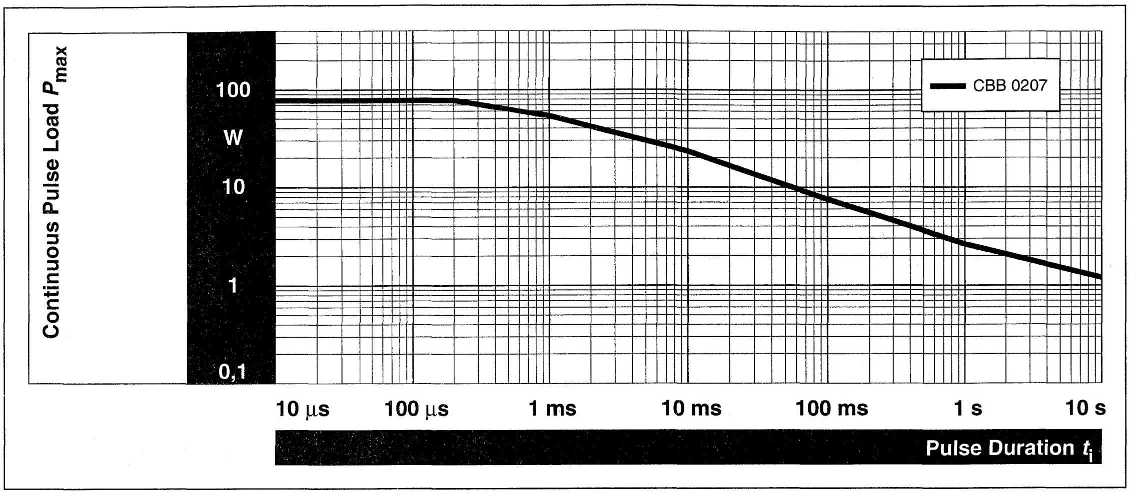


Fig.5 Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8 000 h operation.

Pulse voltage

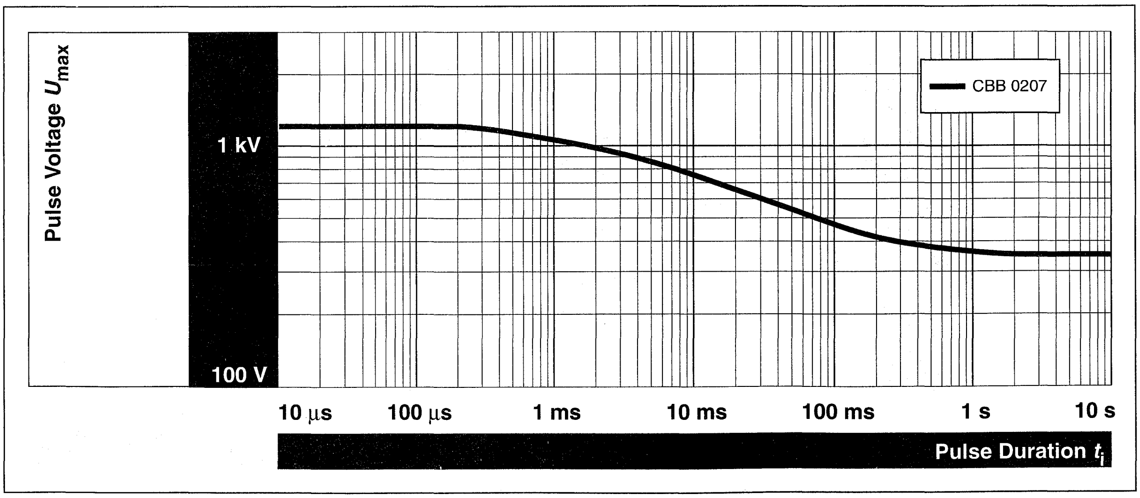


Fig.6 Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8 000 h operation.

1,2/50 pulse

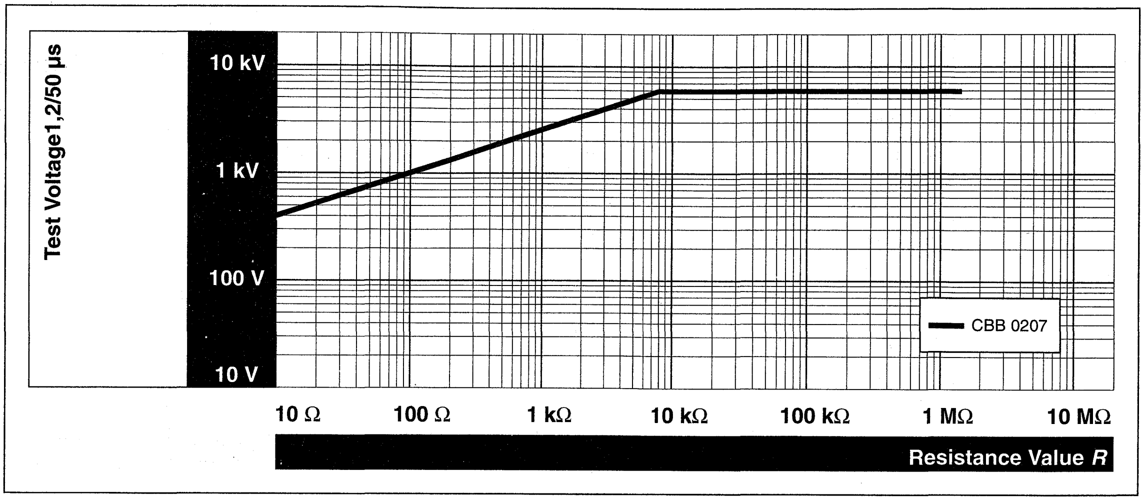


Fig.7 Pulse load rating in accordance with IEC 60115-1, 4.27; 1,2 µs / 50 µs; 5 pulses at 12 s intervals; for permissible resistance change 0,5%.

10/700 pulse

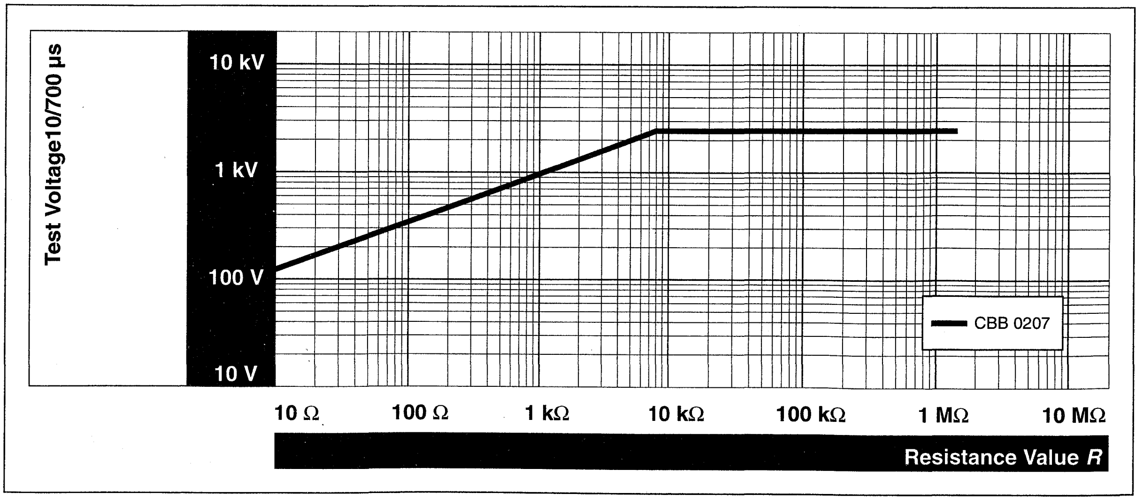


Fig.8 Pulse load rating in accordance with IEC 60115-1, 4.27; 10 µs / 700 µs; 10 pulses at 1 minute intervals; for permissible resistance change 0,5%.

Temperature coefficient (T.C.)

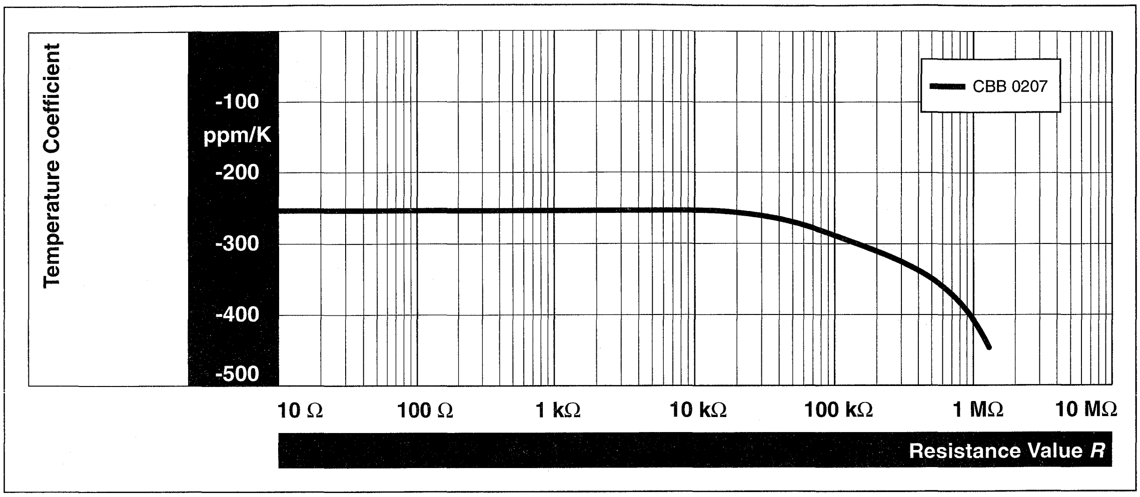


Fig.9 Temperature coefficient of resistance.

Current noise

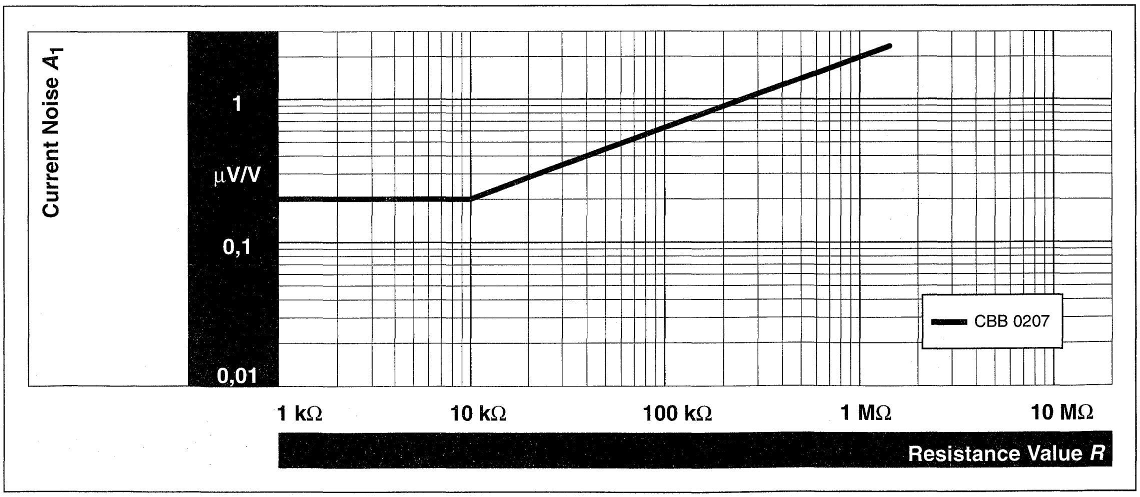
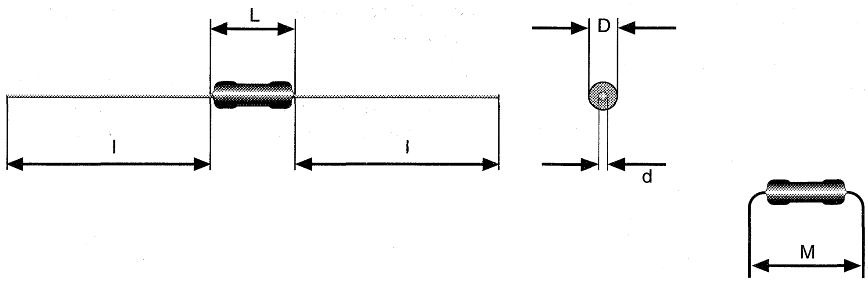


Fig.10 Current Noise A_1 in accordance with IEC 60195.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.11 Outlines.

Table 4 Leaded resistor types, mass and relevant physical dimensions; see Fig.11

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

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)

Table 5 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			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	room temperature; $U = \sqrt{P_{70} \times R}$ or $U = U_{max}$; 1,5 h on; 0,5 h off	
			70 °C; 1 000 h	±(2% + 0,05 Ω)
			70 °C; 8 000 h	±(4% + 0,05 Ω)
4.25.3	–	endurance at upper category temperature	155 °C; 1 000 h	±(4% + 0,1 Ω)
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±(1% + 0,1 Ω)

High pulse load leaded resistor CBB 0207

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR/R)
			Stability for product types: CBB 0207	10 Ω to 1,5 MΩ 10 Ω to 1,5 MΩ
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 to 35 °C	
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	±(1% + 0,1 Ω) no visible damage
–	1 (Aa)	cold	–55 °C; 2 h	±(0,5% + 0,1 Ω)
4.13	–	short time overload	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±(0,5% + 0,1 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±(0,5% + 0,05 Ω) 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 ± 5 °C; 10 ± 1 s	±(0,5% + 0,05 Ω) no visible damage
4.17	20 (Ta)	solderability	+235 °C; 2 s solder bath method	good tinning (≥ 95% covered); no visible damage
4.22	6 (B4)	vibration	6 h; 10 to 2000 Hz 1,5 mm or 196 m/s^2	±(0,5% + 0,05 Ω)
4.16	21 (Ua_1) 21 (Ub) 21 (Uc)	robustness of terminations	tensil, bending and torsion	±(0,5% + 0,05 Ω)
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown

High frequency leaded resistor MBA 0204 HF

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
- Sizes:
  - DIN: 0204
  - CECC: A

APPLICATIONS

- Telecommunication equipment
- Industrial electronics.

DESCRIPTION

MBA 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.

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**.

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

Where applicable, the resistors are tested in accordance with **CECC 40101-806** which refers to **EN 140000 (IEC 60115-1)** and **EN 140100 (IEC 60115-2).**

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

High frequency leaded resistor MBA 0204 HF

QUICK REFERENCE DATA

DESCRIPTION	MBA 0204 HF	
CECC size	A	
Resistance range	1,5 Ω to 470 Ω	
Resistance tolerance	±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	
1 000 h	≤ 0,25%	≤ 0,5%
8 000 h	≤ 0,5%	≤ 1,0%
225 000 h	≤ 1,5%	–
Specified lifetime	225000 h	8000 h
Permissible voltage against ambient:		
1 minute	300 V	
continuous	75 V	
Failure rate	≤ 0,7 × 10^{-9}/h	

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE[(1)]
T.C.	TOLERANCE	MBA 0204 HF
±50 ppm/K	±2%	1,5 Ω to 470 Ω; 50 Ω

Note

1. Resistance values to be selected from E24 series.

High frequency leaded resistor MBA 0204 HF

ORDERING INFORMATION

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

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see Table 2.
- 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 Table 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312	
			BANDOLIER IN BOX; AMMOPACK	
TYPE	T.C.	TOL.	C1 1 000 units	CT 5 000 units
MBA 0204 HF	±50 ppm/K	±2%	903 0....	908 0....

Table 3 Last digit of 12NC indicating resistance decade

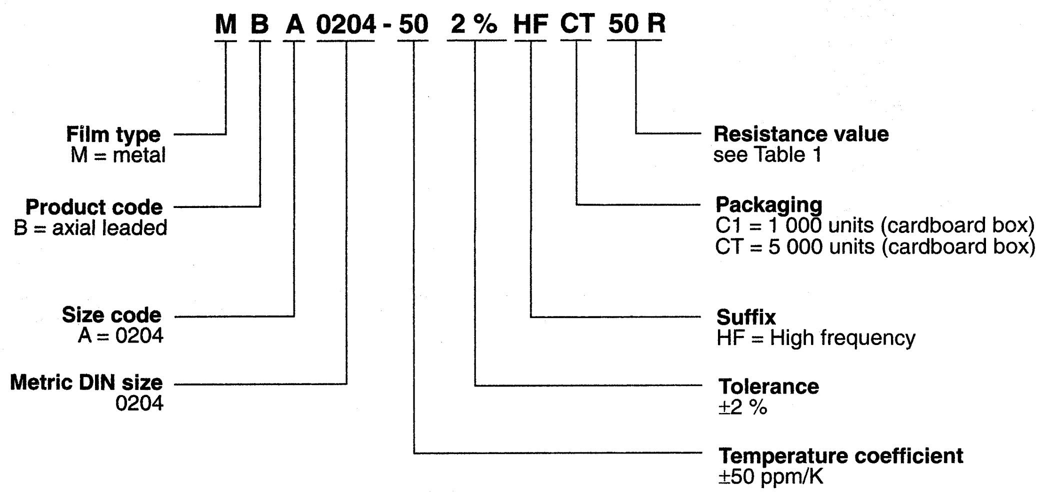
RESISTANCE DECADE	LAST DIGIT
1 Ω to 9,99 Ω	8
10 Ω to 99,9 Ω	9
100 Ω to 999 Ω	1

ORDERING EXAMPLE

The ordering code of a MBA 0204 HF resistor, value 50 Ω and TC 50 with ±2% tolerance, supplied on bandolier, ammopack, in a box of 5000 units is: 2312 908 05009.

Type description and ordering code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.



High frequency leaded resistor MBA 0204 HF

FUNCTIONAL DESCRIPTION

Derating

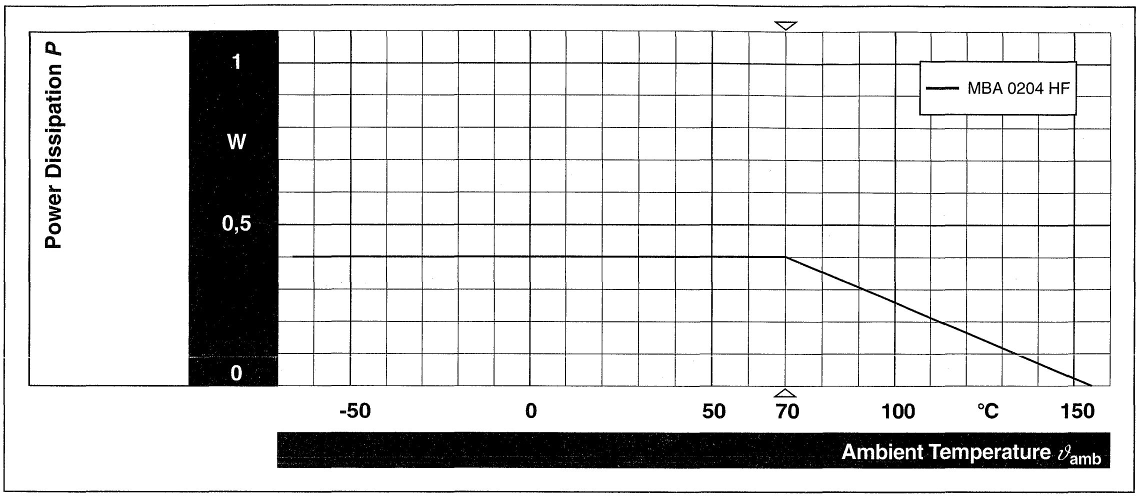


Fig.1 Derating, standard operation.

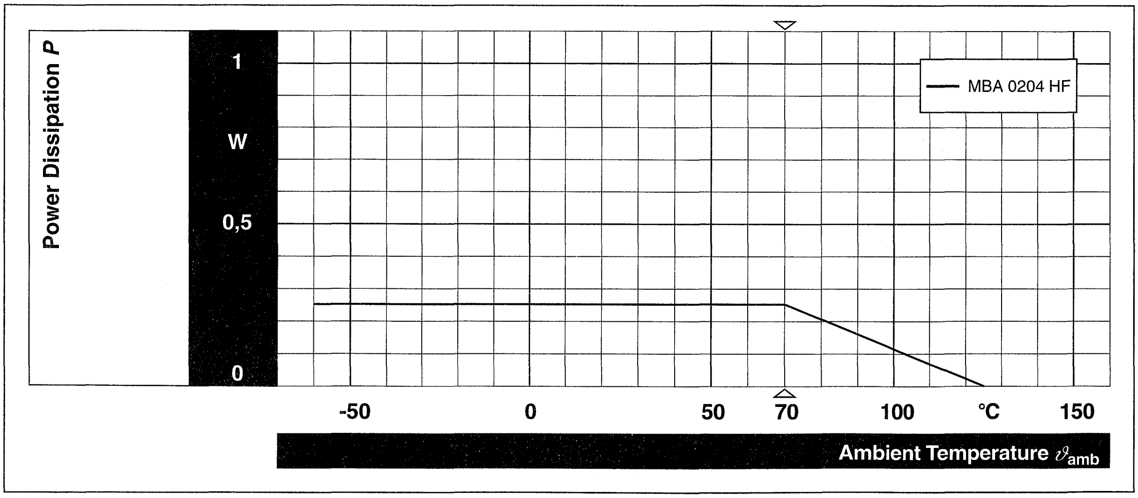


Fig.2 Derating, long term operation.

Temperature rise

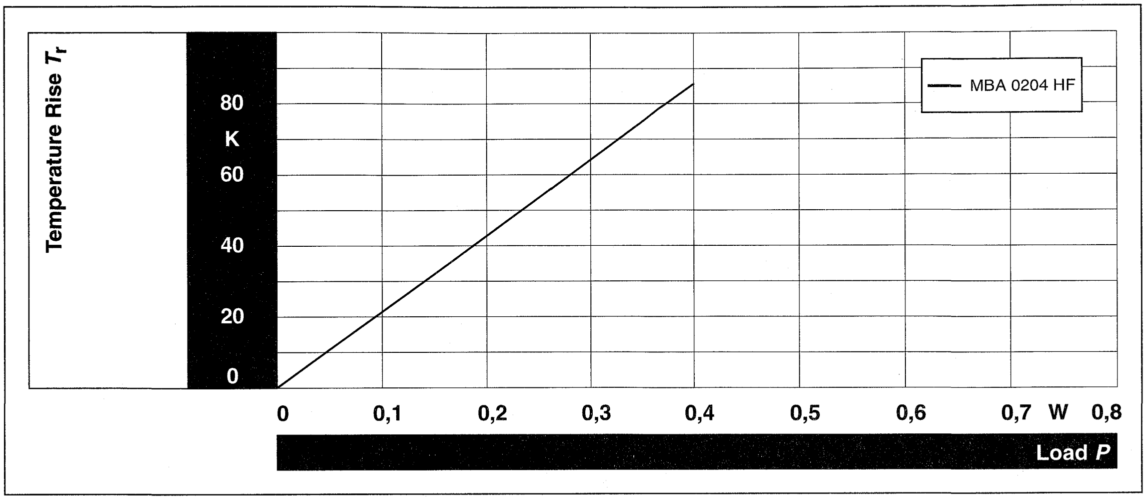


Fig.3 Temperature rise.

RF-behaviour

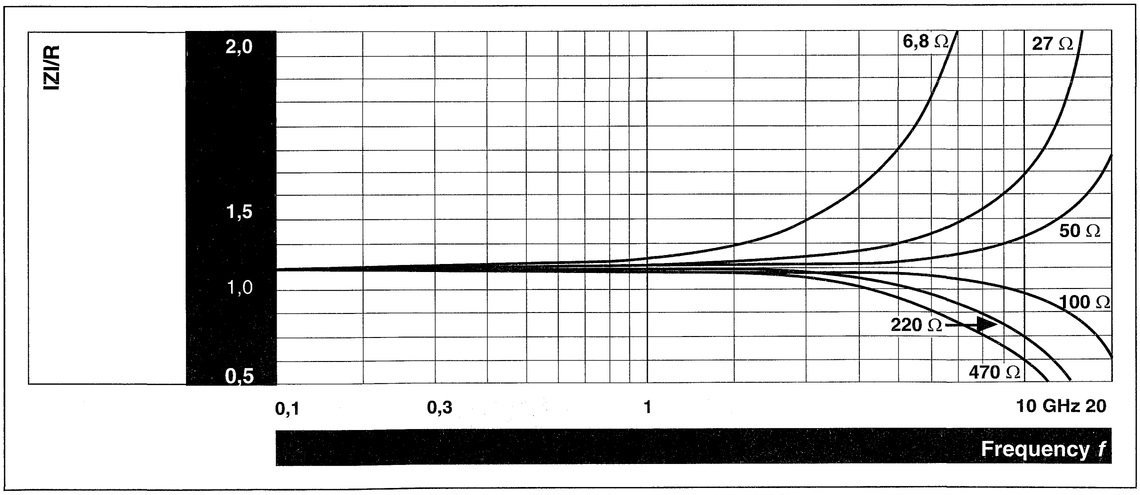
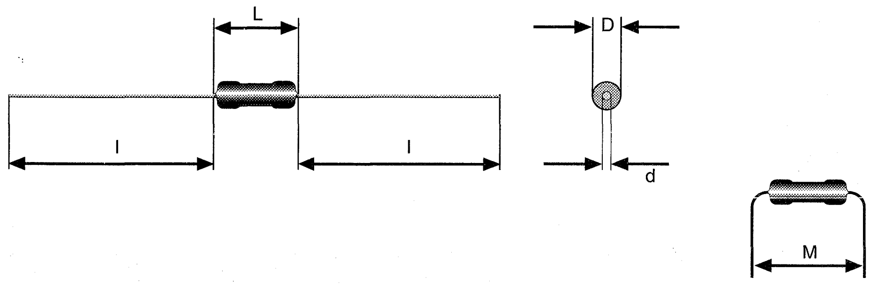


Fig.4 IZI/R for MBA 0204 HF.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.5 Outlines.

Table 4 Leaded resistor types, mass and relevant physical dimensions; see Fig.5

TYPE	D_{max} (mm)	L_{max} (mm)	d_{nom} (mm)	l_{min} (mm)	M_{min} (mm)	MASS (mg)
MBA 0204HF	1,6	3,6	0,5	29,0	5,0	125

High frequency leaded resistor MBA 0204 HF

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)

Table 5 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 1 060 mbar).

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

In Table 5 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types:	**STABILITY CLASS 0,5**
			MBA 0204 HF	1,5 Ω to 470 Ω
4.5	–	resistance		±2%
4.8.4.2	–	temperature coefficient	at 20 / LCT / 20 °C and 20 / UCT / 20 °C	±50 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; 1000 h	±(0,5% + 0,05 Ω)
			70 °C; 8000 h	±(1% + 0,1 Ω)
4.25.3	–	endurance at upper category temperature	155 °C; 1000 h	±(0,5% + 0,05 Ω)
4.24	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–3% RH	±(0,5% + 0,05 Ω)

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)
			stability for product types:	**STABILITY CLASS 0,5**
			MBA 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 to 35 °C	
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100 % RH; 5 cycles	±(0,5% + 0,05 Ω) no visible damage
–	1 (Aa)	cold	−55 °C; 2 h	±(0,1% + 0,01 Ω)
4.13	–	short time overload	room temperature; $U = 2{,}5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	±(0,1% + 0,01 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	±(0,1% + 0,01 Ω) 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 ± 5 °C; 10 ± 1 s	±(0,1% + 0,01 Ω) no visible damage
4.17	20 (Ta)	solderability	+235 °C; 2 s; solder bath method	good tinning (≥ 95% covered); no visible damage
4.22	6 (B4)	vibration	6 h; 10 to 2000 Hz 1,5 mm or 196 m/s^2	±(0,1% + 0,01 Ω)
4.16	21 (Ua_1) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	±(0,1% + 0,01 Ω); no visible damage
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown

POWER PRODUCT DATA

Professional power metal film resistors PR01/02/03

FEATURES

- High power in small packages
- Different lead materials for different applications
- Defined interruption behaviour.

APPLICATIONS

- All general purpose power applications.

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"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE				
	PR01	PR02		PR03	
		Cu-lead	FeCu-lead	Cu-lead	FeCu-lead
Resistance range	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% (E96 series); ±5% (E24 series); see notes 1 and 2				
Maximum dissipation at T_{amb} = 70 °C:					
R < 1 Ω	0.6 W	1.2 W	–	1.6 W	–
1 Ω ≤ 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/R max.: ±5% + 0.1 Ω				
climatic tests	ΔR/R max.: ±3% + 0.1 Ω				
soldering	ΔR/R max.: ±1% + 0.05 Ω				

Notes

1. 1% tolerance is available for R_n-range from 1R upwards.
2. 2% tolerance is available on request for R_n-range from 1R upwards.

ORDERING INFORMATION

Table 1 Ordering code indicating resistor type and packaging

TYPE	LEAD ∅ (mm)	TOL (%)	ORDERING CODE 23.. ... . (BANDOLIER)								
			AMMOPACK							REEL	
			RADIAL TAPED		STRAIGHT LEADS						
					52 mm	52 mm	63 mm	73 mm	80 mm	73 mm	52 mm
			4000 units	3000 units	5000 units	1000 units	500 units	1000 units	500 units	5000 units	5000 units
PR01	Cu 0.6	1	–	–	22 196 1....	–	–	–	–	–	–
		5	06 197 03...	–	22 193 14...	–	–	22 193 13...	–	22 193 23...	06 197 23...
PR02	Cu 0.8	1	–	–	–	22 197 1....	–	–	–	–	–
		5	–	06 198 03...	–	06 198 53...	–	22 194 13...	–	–	06 198 23...
	FeCu 0.6	5	–	–	–	22 194 54...	–	22 194 53...	–	–	–
PR03	Cu 0.8	5	–	–	–	–	22 195 14...	–	22 195 13...	–	–
		1	–	–	–	–	–	–	06 193 5...	–	–
	FeCu 0.6	5	–	–	–	–	22 195 54...	–	22 195 53...	–	–

Table 2 Ordering code indicating resistor type and packaging

TYPE	LEAD ∅ (mm)	TOL (%)	ORDERING CODE 23.. ... . (LOOSE IN BOX)					
			CROPPED AND FORMED(1)		DOUBLE KINK			
			h(2) = 8 mm	h(2) = 15 mm	LARGE PITCH(1)		SMALL PITCH	
			4000 units	5000 units	1000 units	500 units	1000 units	500 units
PR01	Cu 0.6	5	22 193 33... (3)	–	22 193 03...	–	–	–
	FeCu 0.6	5	–	–	22 193 43...	–	22 193 53...	–
PR02	Cu 0.8	5	22 194 33...	22 194 43...	–	–	–	–
	FeCu 0.6	5	22 194 73...(3)	–	22 194 83...	–	–	–
	FeCu 0.8	5	–	–	–	–	22 194 63...	–
PR03	Cu 0.8	5	22 195 33...	22 195 43...	–	–	–	–
	FeCu 0.6	5	22 195 73...(3)	–	–	22 195 83...	–	–
	FeCu 0.8	5	–	–	–	–	–	22 195 63...

Notes

1. Maintenance types, not for new designs.
2. h = mounted height above PCB (see Fig.41).
3. Type can be replaced by double kink, large pitch.

Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 23.
- The first 7 digits indicate the resistor type and packaging; see Tables 1 and 2.
- The remaining 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 3.

Table 3 Last digit of 12NC

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

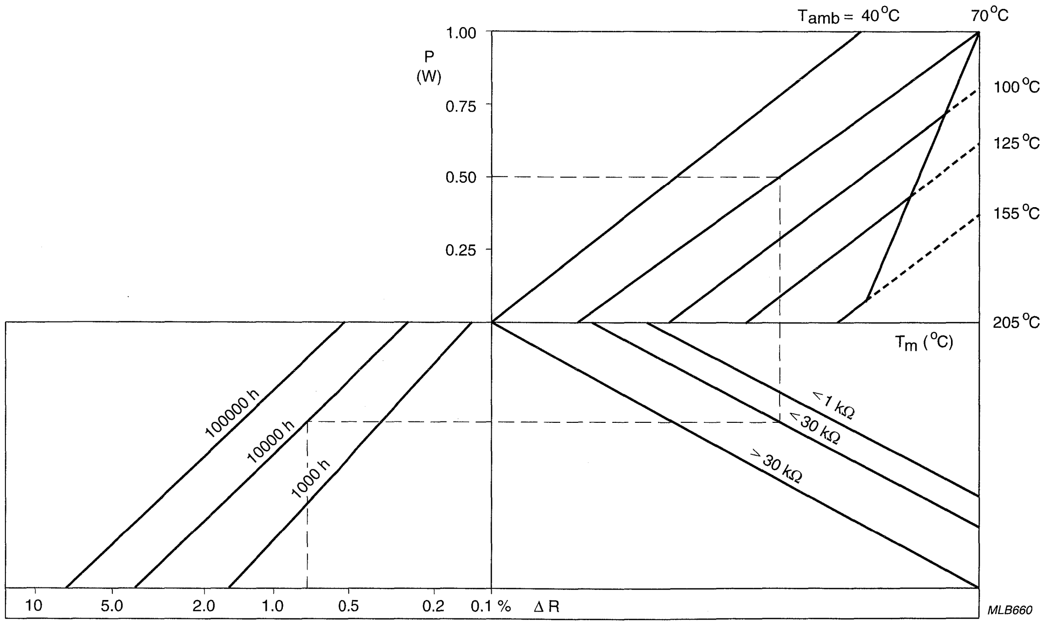
Ordering example

The ordering code for resistor type PR02 with Cu leads and a value of 750 Ω, supplied on a bandolier of 1000 units in ammopack, is: 2322 194 13751.

FUNCTIONAL DESCRIPTION

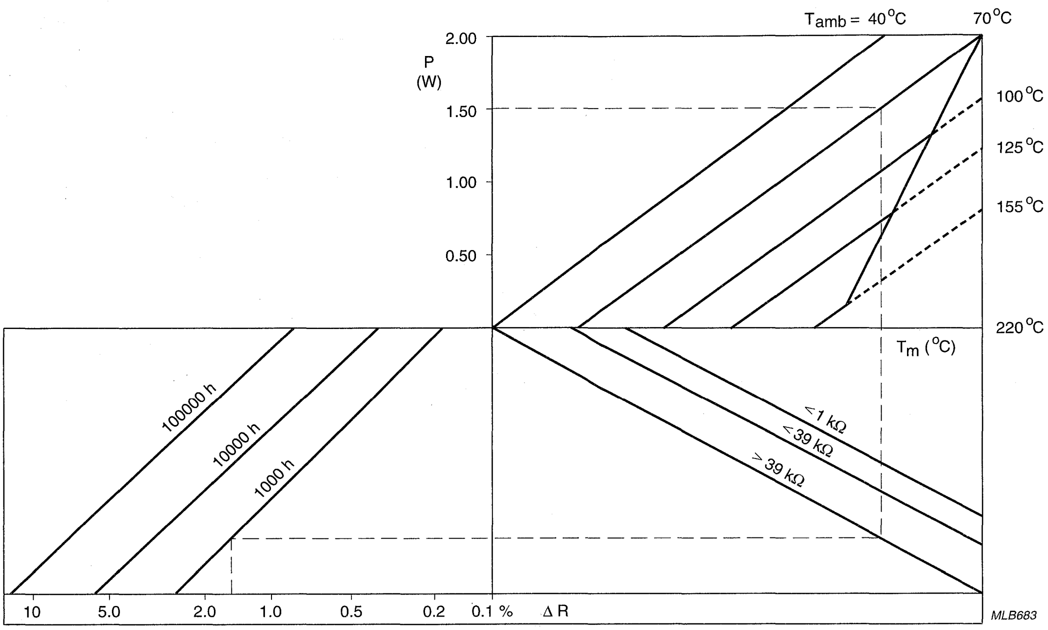
Product characterization

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



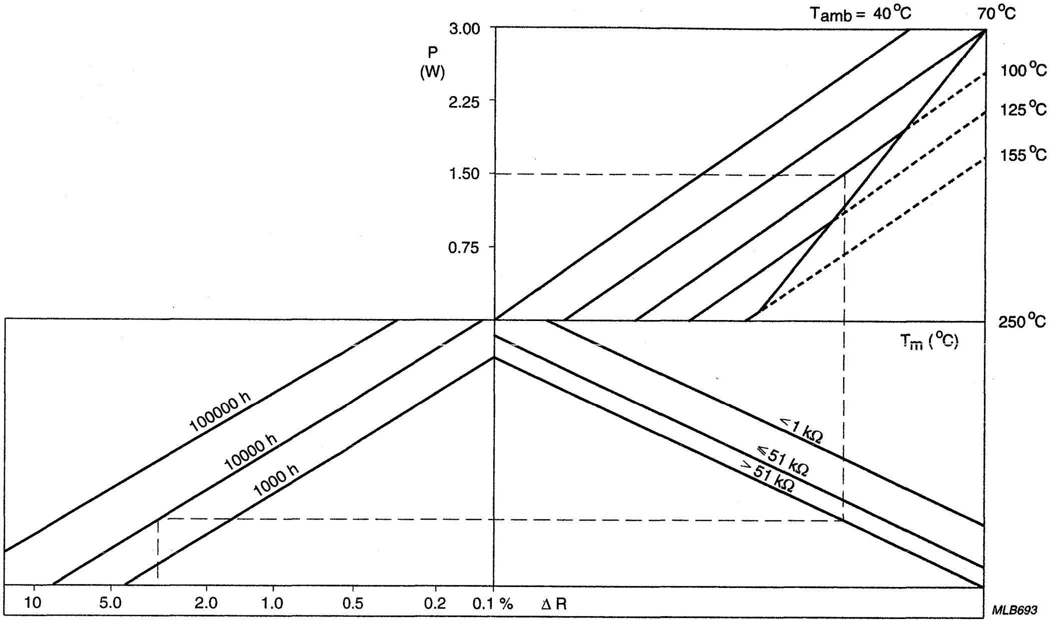
PR01

Fig.1 Drift nomogram.



PR02

Fig.2 Drift nomogram.



PR03

Fig.3 Drift nomogram.

Limiting values

TYPE	LEAD MATERIAL	RANGE	LIMITING VOLTAGE[1] (V)	LIMITING POWER (W)
PR01	Cu	R < 1 Ω	350	0.6
		1 Ω ≤ R		1.0
PR02	Cu	R < 1 Ω	500	1.2
		1 Ω ≤ R		2.0
	FeCu	1 Ω ≤ R		1.3
PR03	Cu	R < 1 Ω	750	1.6
		1 Ω ≤ R		3.0
	FeCu	1 Ω ≤ 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.

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.4.

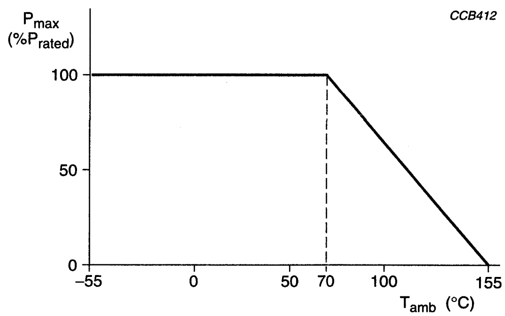
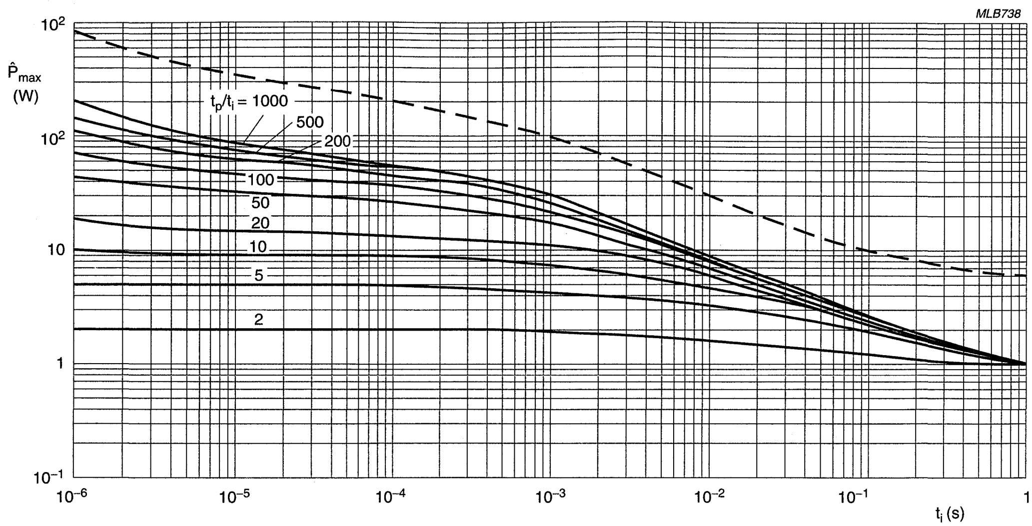


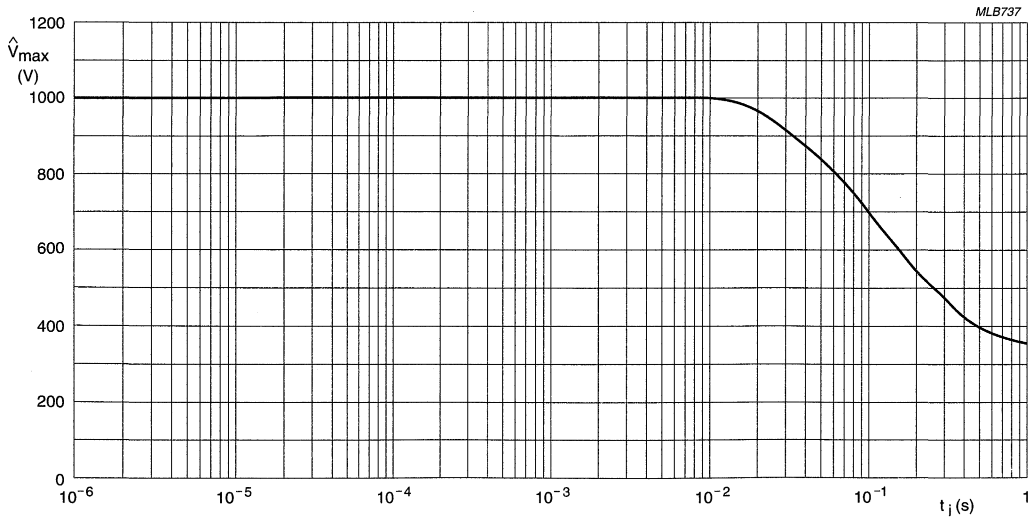
Fig.4 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

PULSE LOADING CAPABILITIES



PR01

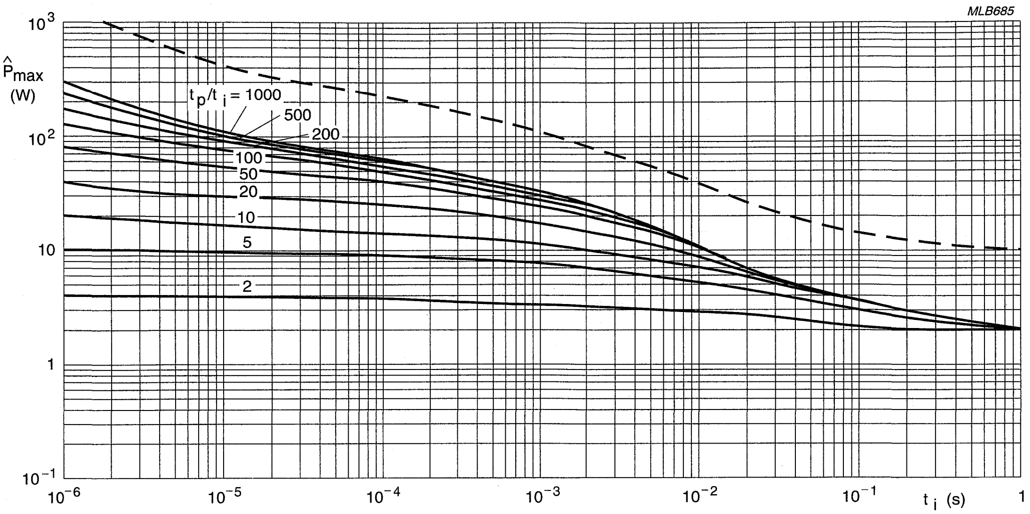
Fig.5 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



PR01

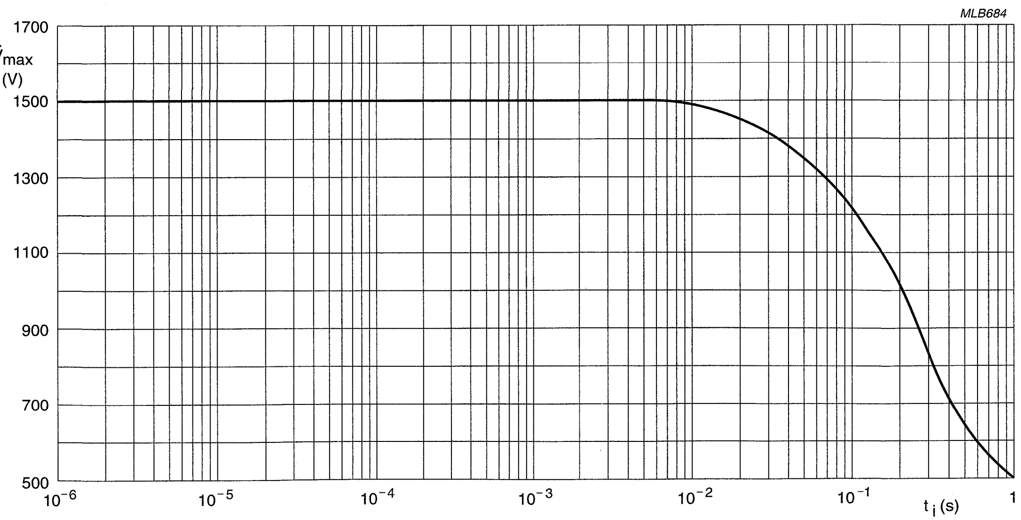
Fig.6 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).

Professional power metal film resistors PR01/02/03



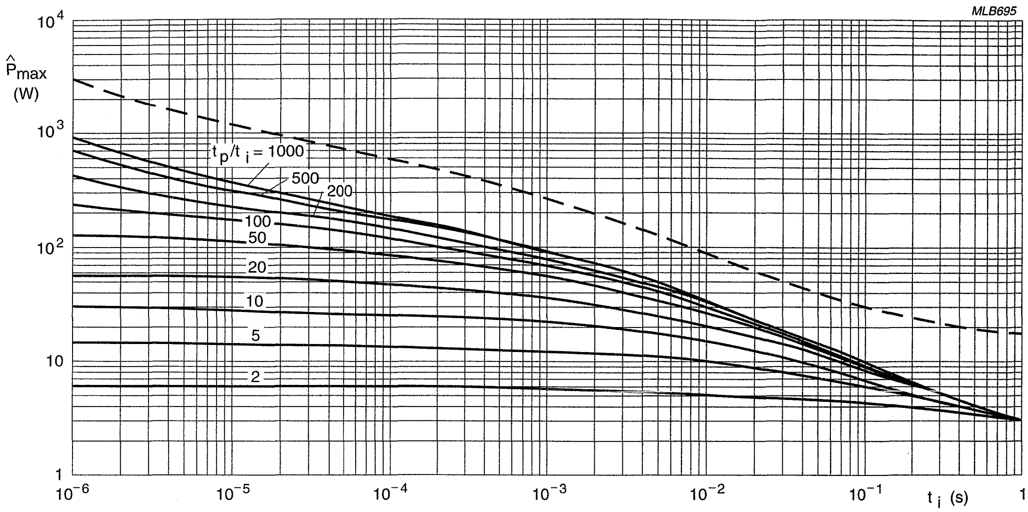
PR02

Fig.7 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



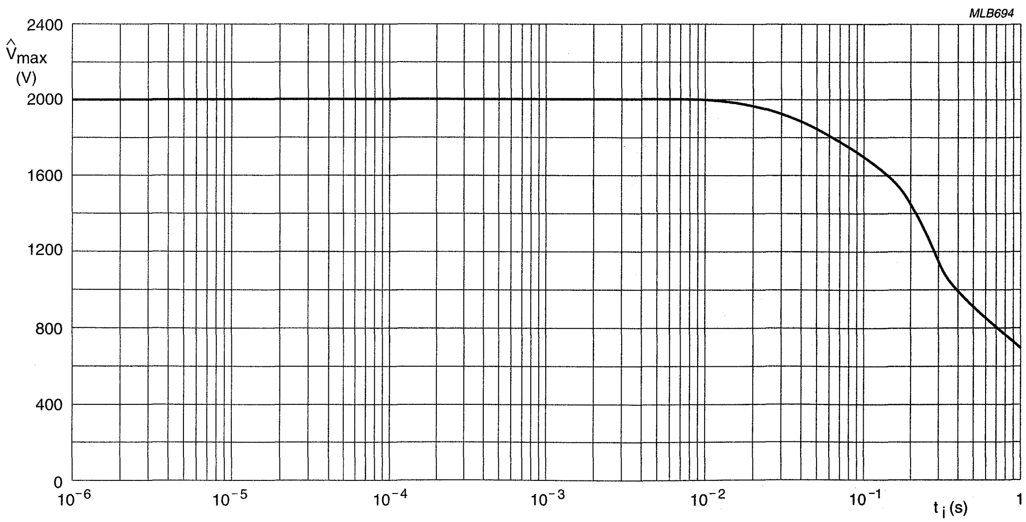
PR02

Fig.8 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).



PR03

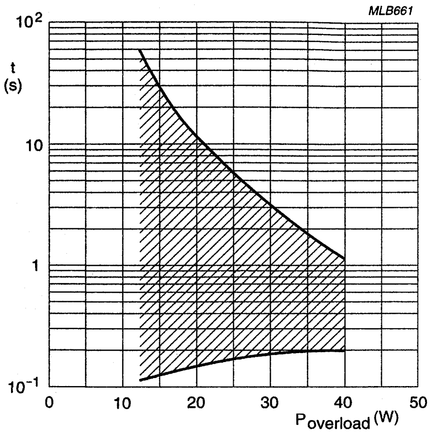
Fig.9 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



PR03

Fig.10 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).

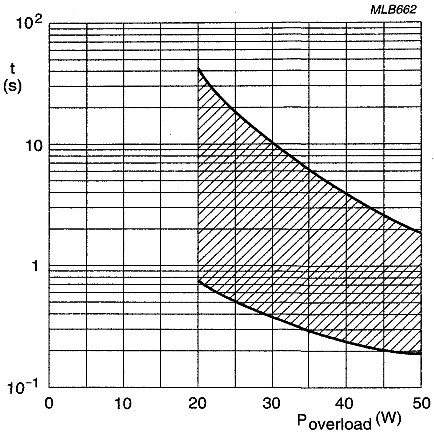
INTERRUPTION CHARACTERISTICS



The graph is based on measured data under constant voltage conditions; these data may deviate according to the application.

PR01

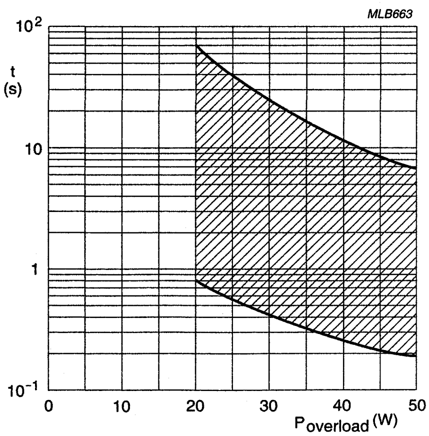
Fig.11 Time to interruption as a function of overload power for range: 0R22 ≤ R_n < 1R.



The graph is based on measured data under constant voltage conditions; these data may deviate according to the application.

PR01

Fig.12 Time to interruption as a function of overload power for range: 1R ≤ R_n ≤ 15R.

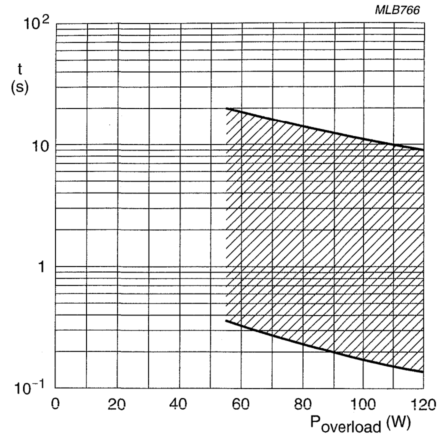


The graph is based on measured data under constant voltage conditions; these data may deviate according to the application.

PR01

Fig.13 Time to interruption as a function of overload power for range: 16R ≤ R_n ≤ 560R.

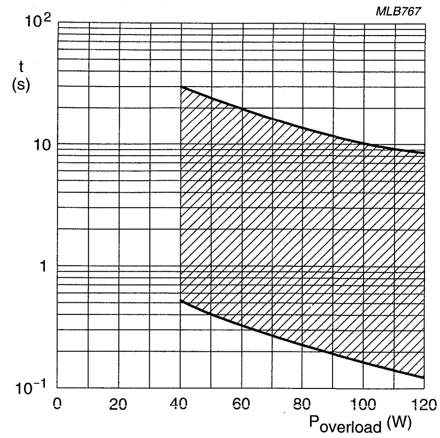
Professional power metal film resistors PR01/02/03



The graph is based on measured data under constant voltage conditions; these data may deviate according to the application.

PR02

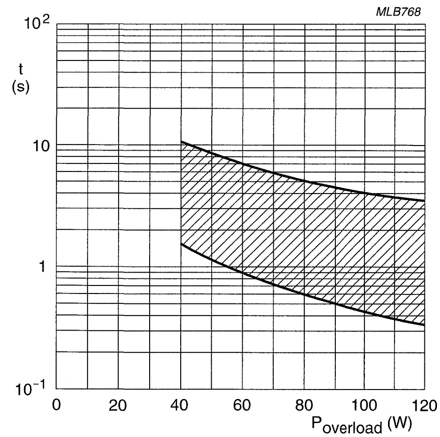
Fig.14 Time to interruption as a function of overload power for range: $0.33R \leq R_n < 5R$.



The graph is based on measured data under constant voltage conditions; these data may deviate according to the application.

PR02

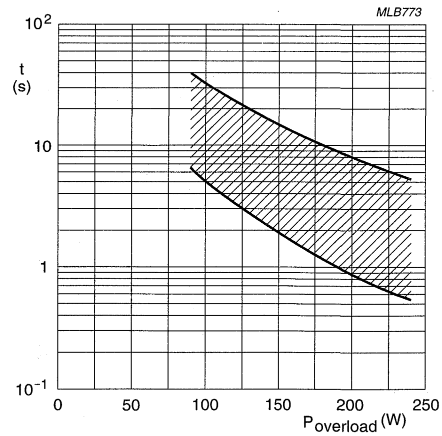
Fig.15 Time to interruption as a function of overload power for range: $5R \leq R_n < 68R$.



The graph is based on measured data under constant voltage conditions; these data may deviate according to the application.

PR02

Fig.16 Time to interruption as a function of overload power for range: $68R \leq R_n \leq 560R$.



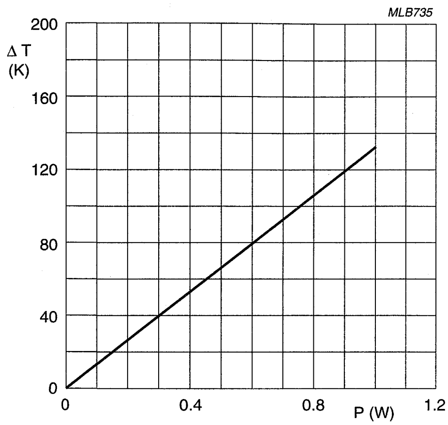
The graph is based on measured data under constant voltage conditions; these data may deviate according to the application.

PR03

Fig.17 Time to interruption as a function of overload power for range: $0.68R \leq R_n \leq 560R$.

Professional power metal film resistors PR01/02/03

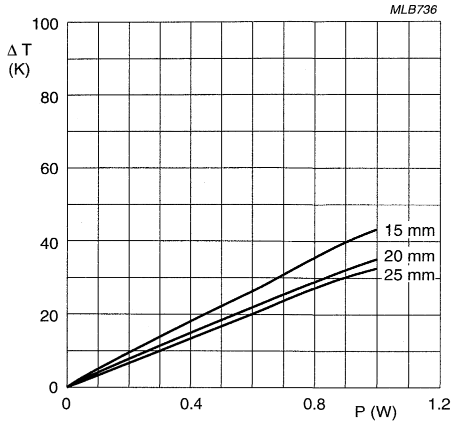
Application information



Ø0.6 mm Cu-leads.

PR01

Fig.18 Hot-spot temperature rise (ΔT) as a function of dissipated power.

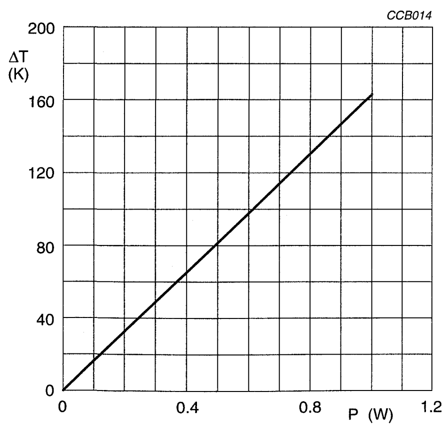


Ø0.6 mm Cu-leads.

Minimum distance from resistor body to PCB = 1 mm.

PR01

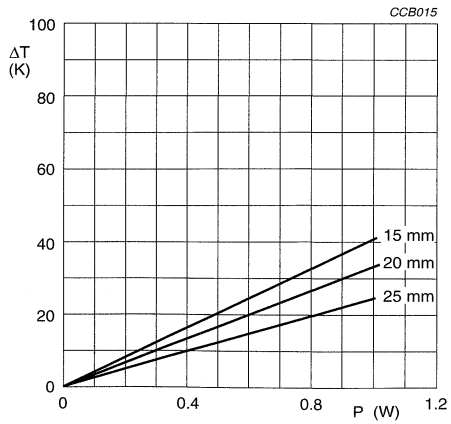
Fig.19 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



Ø0.6 mm FeCu-leads.

PR01

Fig.20 Hot-spot temperature rise (ΔT) as a function of dissipated power.

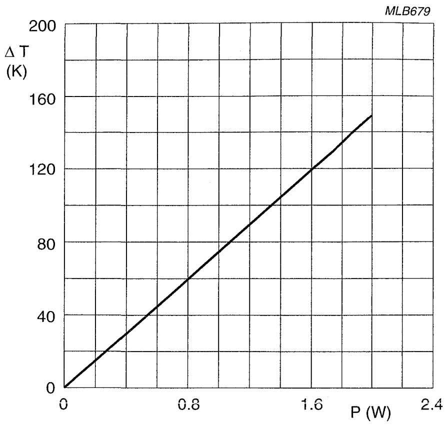


Ø0.6 mm FeCu-leads.

Minimum distance from resistor body to PCB = 1 mm.

PR01

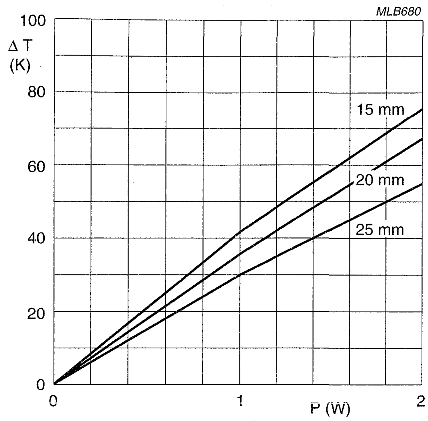
Fig.21 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



Ø0.8 mm Cu-leads.

PR02

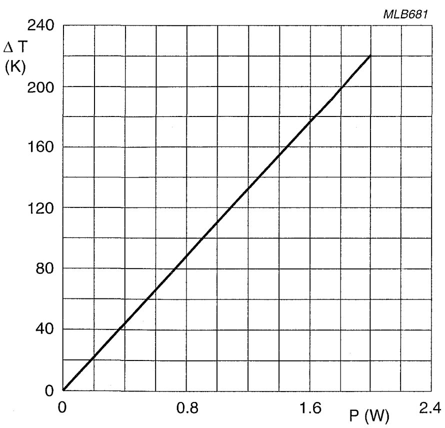
Fig.22 Hot-spot temperature rise (ΔT) as a function of dissipated power.



Ø0.8 mm Cu-leads.
Minimum distance from resistor body to PCB = 1 mm.

PR02

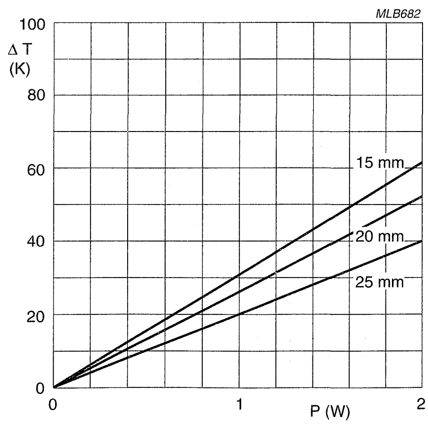
Fig.23 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



Ø0.6 mm FeCu-leads.

PR02

Fig.24 Hot-spot temperature rise (ΔT) as a function of dissipated power.

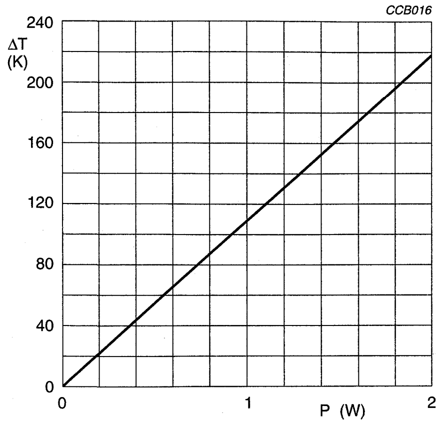


Ø0.6 mm FeCu-leads.
Minimum distance from resistor body to PCB = 1 mm.

PR02

Fig.25 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.

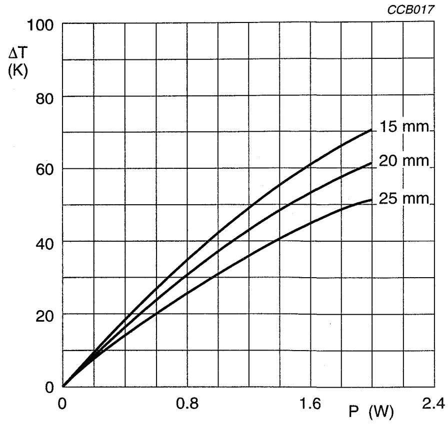
Professional power metal film resistors PR01/02/03



Ø0.8 mm FeCu-leads.

PR02

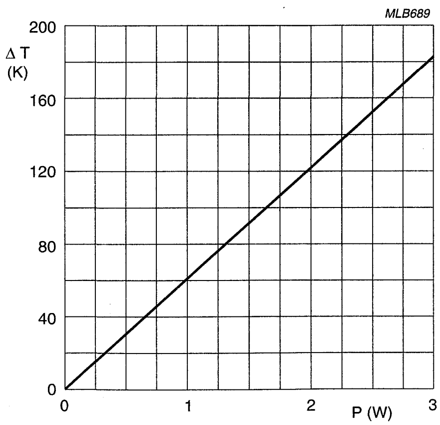
Fig.26 Hot-spot temperature rise (ΔT) as a function of dissipated power.



Ø0.8 mm FeCu-leads.
Minimum distance from resistor body to PCB = 1 mm.

PR02

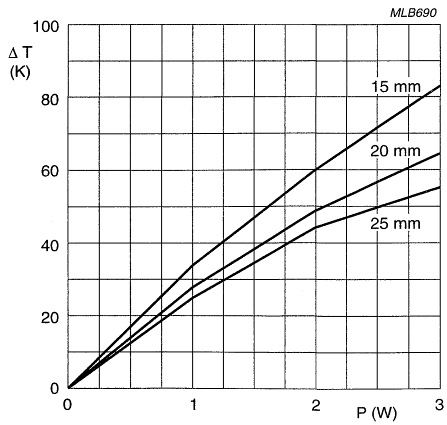
Fig.27 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



Ø0.8 mm Cu-leads.

PR03

Fig.28 Hot-spot temperature rise (ΔT) as a function of dissipated power.

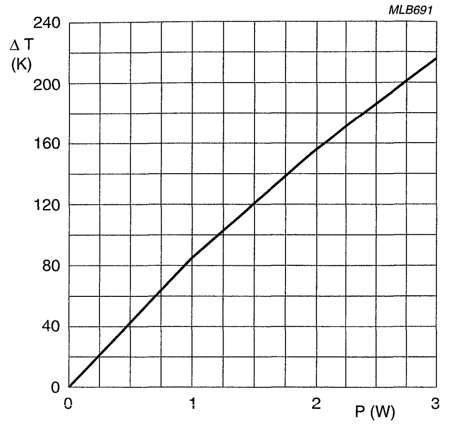


Ø0.8 mm Cu-leads.
Minimum distance from resistor body to PCB = 1 mm.

PR03

Fig.29 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.

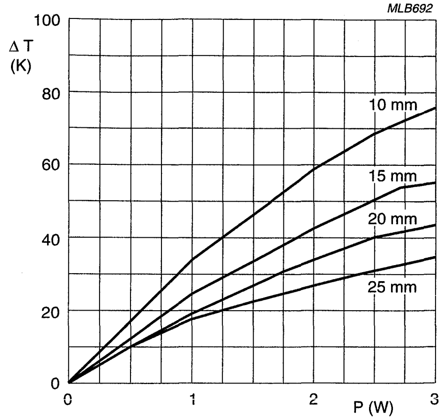
Professional power metal film resistors PR01/02/03



Ø0.6 mm FeCu-leads.

PR03

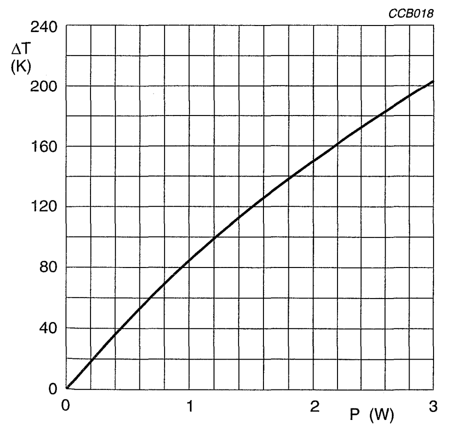
Fig.30 Hot-spot temperature rise (ΔT) as a function of dissipated power.



Ø0.6 mm FeCu-leads.
Minimum distance from resistor body to PCB = 1 mm.

PR03

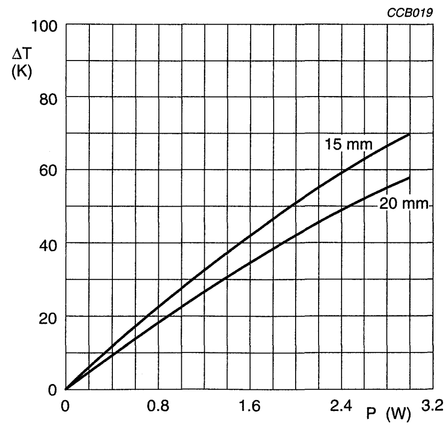
Fig.31 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



Ø0.8 mm FeCu-leads.

PR03

Fig.32 Hot-spot temperature rise (ΔT) as a function of dissipated power.



Ø0.8 mm FeCu-leads.
Minimum distance from resistor body to PCB = 1 mm.

PR03

Fig.33 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.

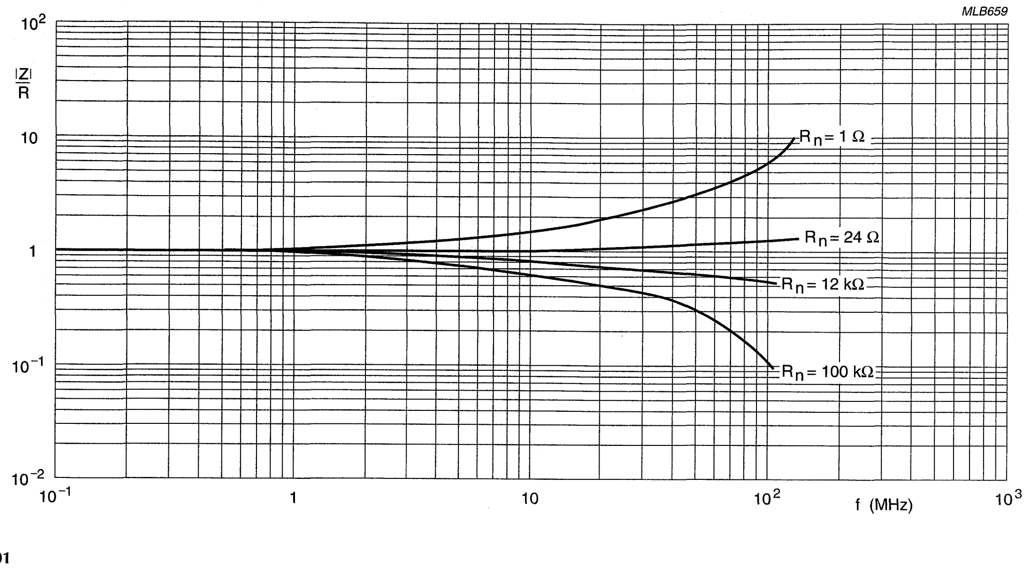


Fig.34 Impedance as a function of applied frequency.

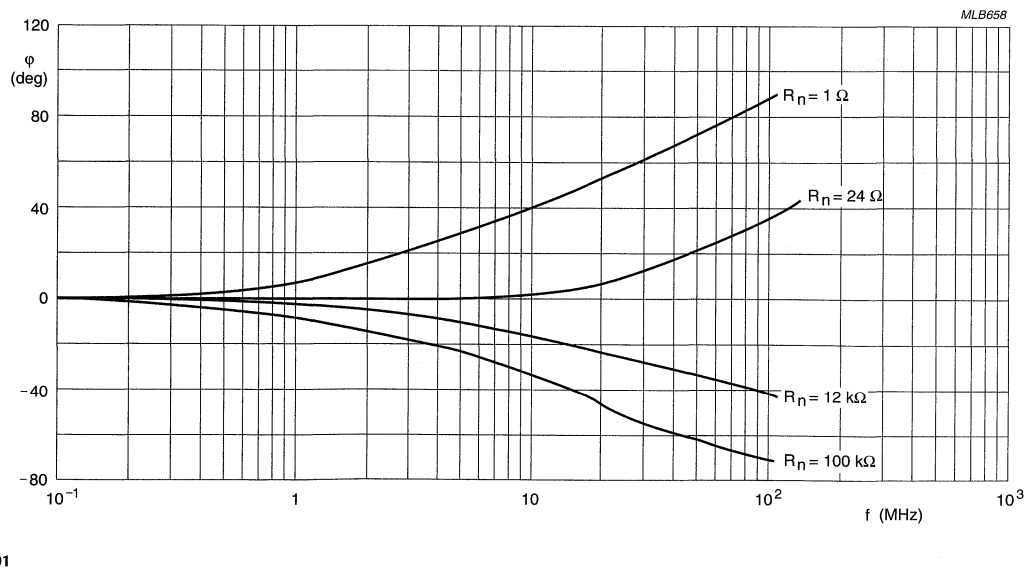
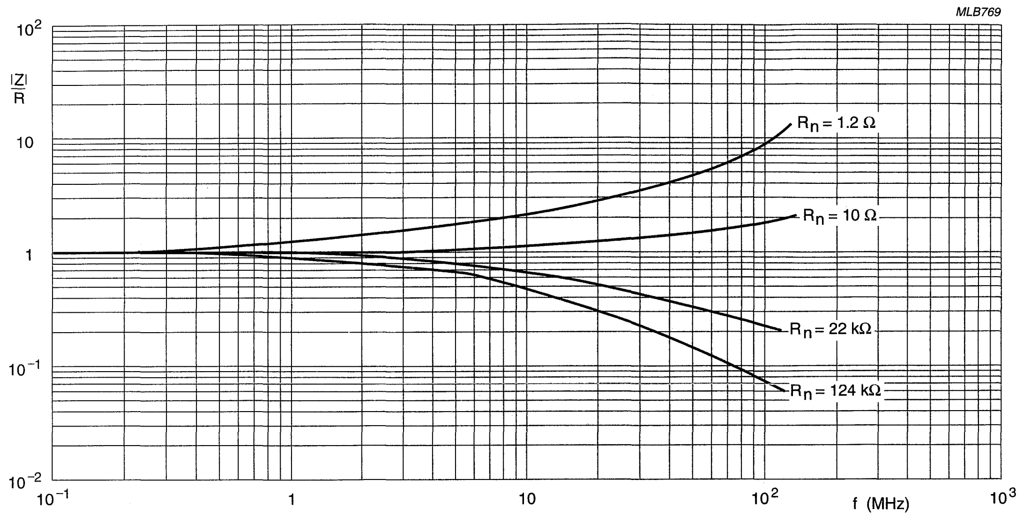
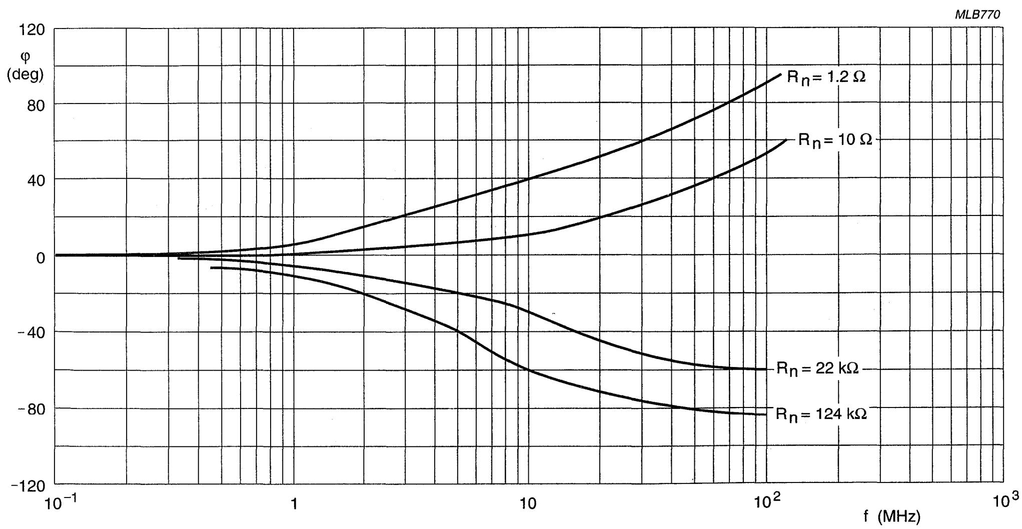


Fig.35 Phase angle as a function of applied frequency.



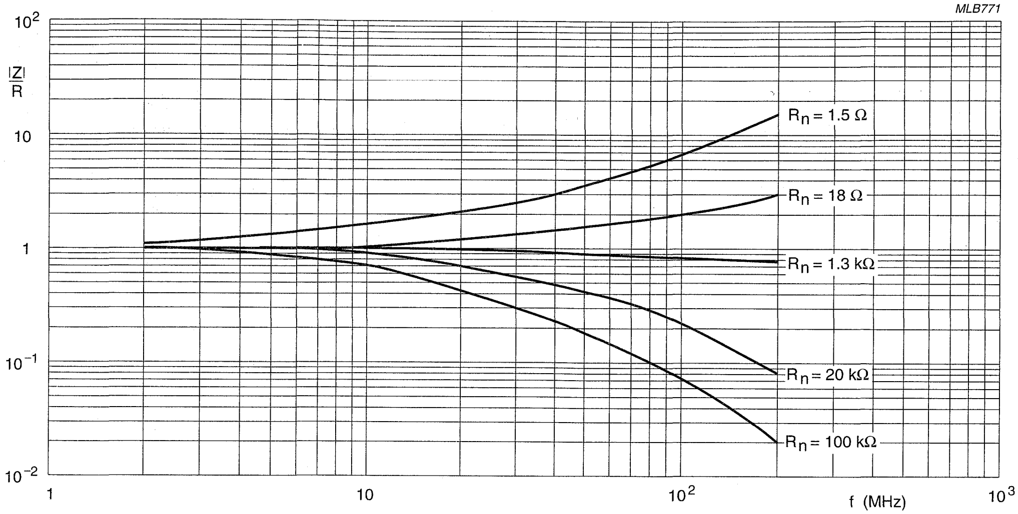
PR02

Fig.36 Impedance as a function of applied frequency.



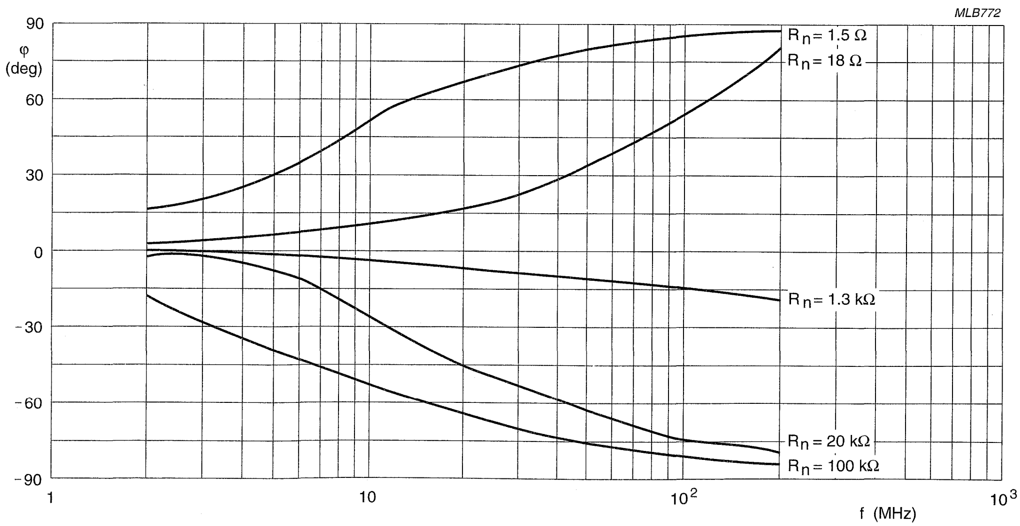
PR02

Fig.37 Phase angle as a function of applied frequency.



PR03

Fig.38 Impedance as a function of applied frequency.



PR03

Fig.39 Phase angle as a function of applied frequency.

MECHANICAL DATA

Mass per 100 units

TYPE	LEAD MATERIAL	MASS (g)
PR01	Cu	29
	FeCu	29
PR02	Cu	63
	FeCu	45
PR03	Cu	110
	FeCu	100

Mounting

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

Marking

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

Outlines

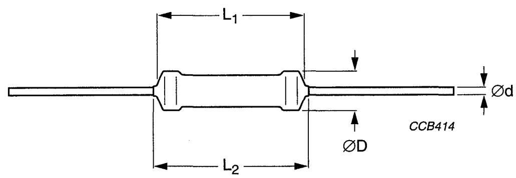
The length of the body (L_1) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation
("IEC publication 60294").

Mounting pitch

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

Note

1. Recommended minimum value.

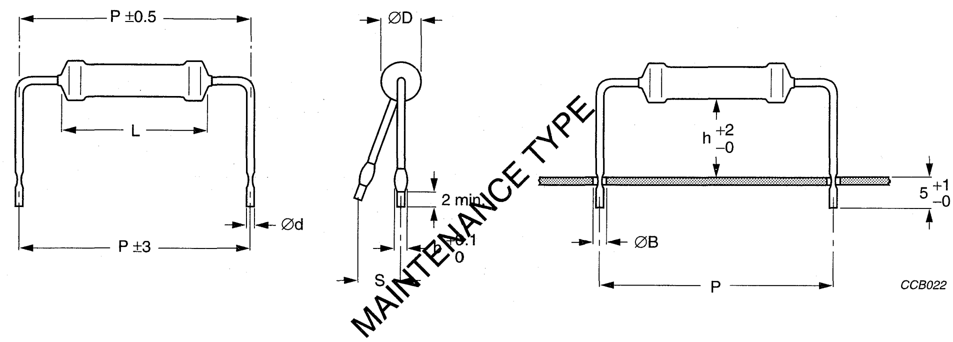


For dimensions see Table 4.

Fig.40 Type with straight leads.

Table 4 Straight lead type and relevant physical dimensions: see Fig.40

TYPE	ØD MAX. (mm)	L_1 MAX. (mm)	L_2 MAX. (mm)	Ød (mm)
PR01	2.5	6.5	8.5	0.58 ±0.05
PR02	3.9	10.0	12.0	0.8 ±0.03
				0.58 ±0.05
PR03	5.2	16.7	19.5	0.8 ±0.03
				0.58 ±0.05



Dimensions in mm.
For dimensions see Tables 4 and 5.

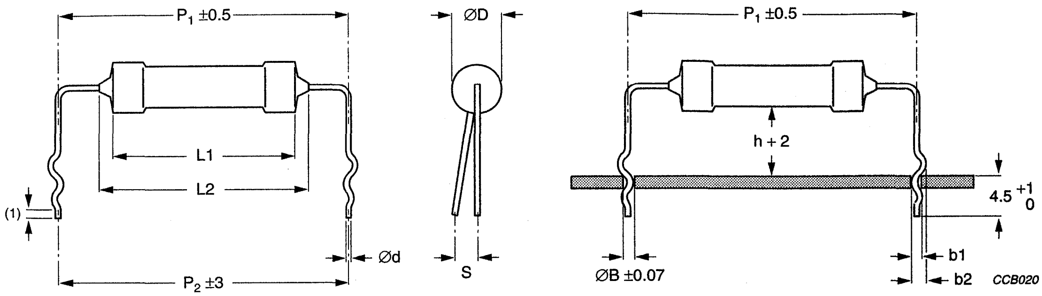
Fig.41 Type with cropped and formed leads.

Table 5 Cropped and formed lead type and relevant physical dimensions; see Fig.41

TYPE	LEAD STYLE	Ød (mm)	b (mm)	h (mm)	P (mm)	S MAX. (mm)	ØB MAX. (mm)
PR01	cropped and formed; note 1	0.6 ±0.05	1.1	8	17.8	2	1.0
PR02		0.8 ±0.03	1.3	8	17.8	2	1.2
		0.8 ±0.03	1.3	15		3	1.2
		0.6 ±0.05	1.1	8		2	1.0
PR03		0.8 ±0.03	1.3	8	25.4	2	1.2
		0.8 ±0.03	1.3	15		3	1.2
		0.6 ±0.05	1.1	8		2	1.0

Note

1. Can be replaced by double kinked versions; see Fig.42.



Dimensions in mm.
For dimensions see Tables 4 and 6.
(1) Ø0.8 to 1.4 or Ø0.6 to 1.6.

Fig.42 Type with double kink.

Table 6 Double kink lead type and relevant physical dimensions; see Fig.42

TYPE	LEAD STYLE	Ød (mm)	b1 (mm)	b2 (mm)	h (mm)	P_1 (mm)	P_2 (mm)	S MAX. (mm)	ØB (mm)
PR01	double kink large pitch	0.58 ±0.05	1.10 +0.25/−0.20	1.45 +0.25/−0.20	8	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	8	12.5	12.5	2	0.8
PR02	double kink large pitch	0.58 ±0.05	1.10 +0.25/−0.20	1.45 +0.25/−0.20	8	17.8	17.8	2	0.8
	double kink small pitch	0.8 ±0.03	1.30 +0.25/−0.20	1.65 +0.25/−0.20	8	15.0	15.0	2	1.0
PR03	double kink large pitch	0.58 ±0.05	1.10 +0.25/−0.20	1.45 +0.25/−0.20	8	25.4	25.4	2	0.8
	double kink small pitch	0.8 ±0.03	1.30 +0.25/−0.20	2.15 +0.25/−0.20	8	22.0	20.0	2	1.0

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: **L**ower **C**ategory **T**emperature, **U**pper **C**ategory **T**emperature; 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 Table 7 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.

Table 7 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 Tables 4, 5 and 6
4.5		resistance	applied voltage (+0/–10%): R < 10 Ω: 0.1 V 10 Ω ≤ R < 100 Ω: 0.3 V 100 Ω ≤ R < 1 kΩ: 1 V 1 kΩ ≤ R < 10 kΩ: 3 V 10 kΩ ≤ R < 100 kΩ: 10 V 100 kΩ ≤ R < 1 MΩ: 25 V R = 1 MΩ: 50 V	$R - R_{nom}$: max. ±5%
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 6 mm from body	ΔR/R max.: ±1% + 0.05 Ω
4.29	45 (Xa)	component solvent resistance	isopropyl alcohol or H_2O 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 minute; metal block method	no breakdown or flashover

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 10 N; 10 s	number of failures: $<1 \times 10^{-6}$
4.16.3	21 (Ub)	bending half number of samples	load 5 N; $4 \times 90°$	number of failures: $<1 \times 10^{-6}$
4.16.4	21 (Uc)	torsion other half of samples	$3 \times 360°$ in opposite directions	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.20	29 (Eb)	bump	3 × 1 500 bumps in three directions; 40 g	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.22	6 (Fc)	vibration	frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10 g; three directions; total 6 hours (3 × 2 hours)	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	no visual damage **PR01**: ΔR/R max.: ±1% + 0.05 Ω **PR02**: ΔR/R max.: ±1% + 0.05 Ω **PR03**: ΔR/R max.: ±2% + 0.05 Ω
4.23		climatic sequence:		
4.23.3	30 (Db)	damp heat (accelerated) 1st cycle		
4.23.6	30 (Db)	damp heat (accelerated) remaining cycles	6 days; 55 °C; 95 to 98% RH	R_{ins} min.: 10^3 MΩ ΔR/R max.: ±3% + 0.1 Ω
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.: 1 000 MΩ ΔR/R max.: ±3% + 0.1 Ω
4.25.1		endurance (at 70 °C)	1 000 hours; loaded with P_n or V_{max}; 1.5 hours on and 0.5 hours off	ΔR/R max.: ±5% + 0.1 Ω
4.8.4.2		temperature coefficient	at 20/LCT/20 °C and 20/UCT/20 °C (TC × 10^{-6}/K)	≤±250
Other tests in accordance with IEC 60115 clauses and IEC 60068 test method				
4.17	20 (Tb)	solderability (after ageing)	8 hours steam or 16 hours 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 minute; metal block method	R_{ins} min.: 10^4 MΩ
see 2nd amendment to IEC 60015-1, Jan. '87		pulse load		see Figs 5, 6, 7, 8, 9 and 10

Cemented wirewound resistors AC01/03/04/05/07/10/15/20

FEATURES

- High power dissipation in small volume
- High pulse load handling capabilities.

APPLICATIONS

- Ballast switching
- Shunt in small electric motors
- Power supplies.

DESCRIPTION

The resistor element is a resistive wire which is wound in a single layer on a ceramic rod. Metal caps are pressed over the ends of the rod.
The ends of the resistance wire and the leads are connected to the caps by welding. Tinned copper-clad iron leads with poor heat conductivity are employed permitting the use of relatively short leads to obtain stable mounting without overheating the solder joint.

The resistor is coated with a green silicon cement which is not resistant to aggressive fluxes. The coating is non-flammable, will not drip even at high overloads and is resistant to most commonly used cleaning solvents, in accordance with *"MIL-STD-202E, method 215"* and *"IEC 60068-2-45"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE							
	AC01	AC03	AC04	AC05	AC07	AC10	AC15	AC20
Resistance range	0.1 Ω to 2.4 kΩ	0.1 Ω to 5.1 kΩ	0.1 Ω to 6.8 kΩ	0.1 Ω to 10 kΩ	0.1 Ω to 15 kΩ	0.68 Ω to 27 kΩ	0.82 Ω to 39 kΩ	1.2 Ω to 56 kΩ
Resistance tolerance	±5%; E24 series							
Maximum permissible body temperature	350 °C							
Rated dissipation at T_{amb} = 40 °C	1 W	3 W	4 W	5 W	7 W	10 W	15 W	20 W
Rated dissipation at T_{amb} = 70 °C	0.9 W	2.5 W	3.5 W	4.7 W	5.8 W	8.4 W	12.5 W	16 W
Climatic category (IEC 60068)	40/200/56							
Basic specification	IEC 60115-1							
Stability after:								
load, 1000 hours	ΔR/R max.: ±5% + 0.1 Ω							
climatic tests	ΔR/R max.: ±1% + 0.05 Ω							
short time overload	ΔR/R max.: ±2% + 0.1 Ω							

Cemented wirewound resistors AC01/03/04/05/07/10/15/20

ORDERING INFORMATION

Table 1 Ordering code indicating resistor type and packaging

TYPE	ORDERING CODE 23..			
	LOOSE IN BOX	BANDOLIER IN AMMOPACK		
	STRAIGHT LEADS	RADIAL	STRAIGHT LEADS	
	100 units	2500 units	500 units	1000 units
AC01	–	06 328 90...(2)	–	06 328 33...
AC03(1)	–	–	22 329 03...	–
AC04(1)	–	–	22 329 04...	–
AC05(1)	–	–	22 329 05...	–
AC07(1)	–	–	22 329 07...	–
AC10	–	–	22 329 10...	–
AC15	22 329 15...	–	–	–
AC20	22 329 20...	–	–	–

Notes

1. Products with bent leads and loose in box, are available on request.
2. Last 3 digits available on request.

Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 23
- The subsequent 7 digits indicate the resistor type and packaging; see Table 1.
- The remaining 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 2.

Table 2 Last digit of 12NC

RESISTANCE DECADE	LAST DIGIT
0.1 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 56 kΩ	3

ORDERING EXAMPLE

The ordering code of an AC01 resistor, value 47 Ω, supplied in ammopack of 1000 units is: 2306 328 33479.

Product specifications deviating from the standard values are available on request.

Cemented wirewound resistors AC01/03/04/05/07/10/15/20

FUNCTIONAL DESCRIPTION

Product characterization

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

Limiting values

TYPE	LIMITING VOLTAGE[(1)] (V)	LIMITING POWER (W)	
		T_{amb} = 40 °C	T_{amb} = 70 °C
AC01	$V = \sqrt{P_n \times R}$	1	0.9
AC03		3	2.5
AC04		4	3.5
AC05		5	4.7
AC07		7	5.8
AC10		10	8.4
AC15		15	12.5
AC20		20	16.0

Note

1. The maximum voltage that may be continuously applied to the resistor element, see *"IEC publication 60266"*.

The maximum permissible hot-spot temperature is 350 °C.

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.1.

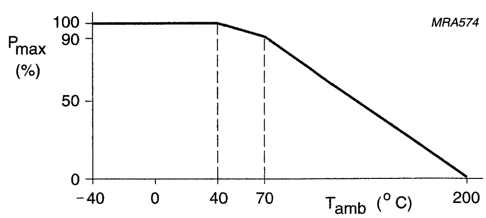


Fig.1 Maximum dissipation (P_{max}) as a function of the ambient temperature (T_{amb}).

PULSE LOADING CAPABILITIES

How to generate the maximum allowed pulse-load from the graphs composed for wirewound resistors of the AC-types.

Single pulse condition; see Fig.3

If the applied pulse energy in Joules or Wattseconds is known and also the R-value to be used in the application; take the R-value on the X-axis and go vertically to the curved line. From this point go horizontally to the Y-axis, this point gives the maimum allowed pulse energy in Joules/ohm or Wattsec./ohm. By multiplying this figure with -value in use gives the maximum allowed pulse-energy in Joules or Wattsec. If this figure is higher than the applied pulse-energy the application is allowed. Otherwise take one of the other graphs belonging to AC-types with higher P_n.

If, contrary to the information above, the applied peak-voltage and impulse times t_i are known. Calculate the pulse-energy (E_p) in Joules or Wattsec. by the use of the following formula:

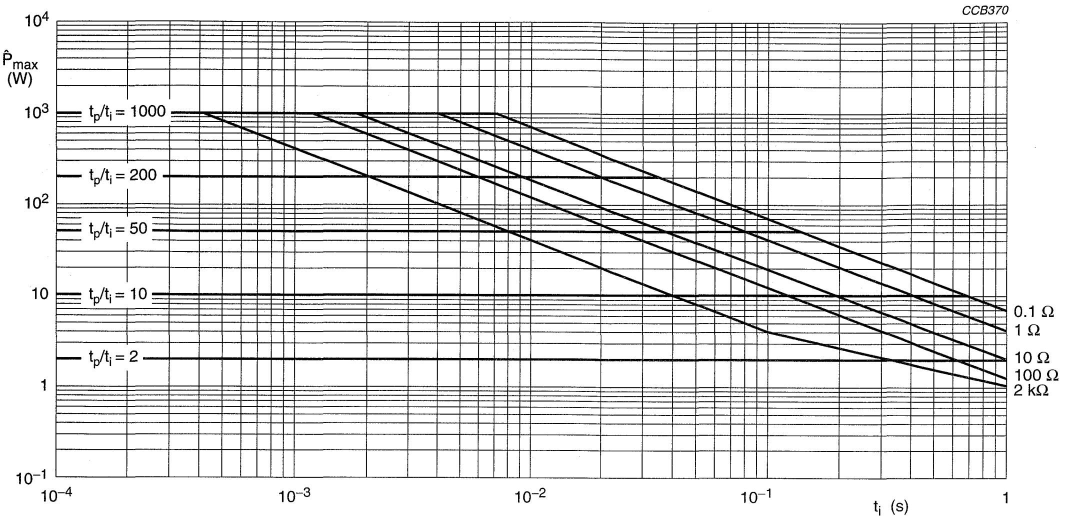
$$Ep = \frac{Vp^2}{R} \times t_i \quad (V_p = \text{peak voltage; } t_i = \text{impulse-time})$$

By dividing this result with the R_n-value of the R in use, gives the value Wattsec./ohm on the Y-axis. Draw a line horizontally to the curved line and at the intersection the vertical line to the X-axis gives the maximum allowed R_n-value to be used in the application. If this R_n -value is higher than the R-value to be used in the application, the application is allowed. If not, take one of the other graphs belonging to AC-types with higher P_n or change the R_n-value to be used.

Repetitive pulse condition; see Fig.2

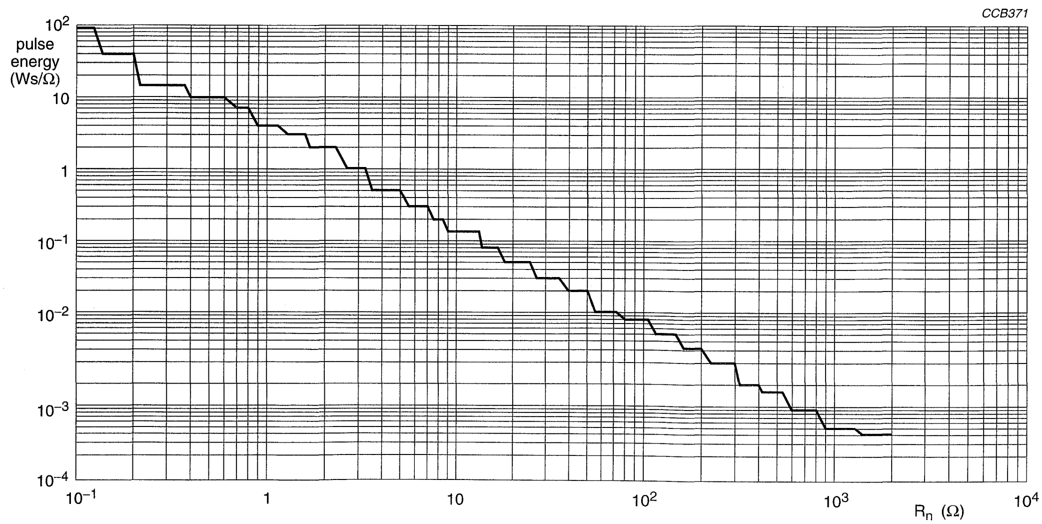
With these graphs we can determine the allowed pulse-energy in Watts depending on the impulse- time t_i and the repetition time t_p of the pulses. The parameter is the Resistance Value. If the pulse shape is known (impulse-time t_i and repetition time t_p), draw a line vertically from the X-axis at the mentioned t_i to the line of the involved R-value. From the intersection the horizontal line to the Y- axis indicates the maximum allowed pulse-load at a certain t_p/t_i. If the vertical line from the X-axis crosses the applied t_p/t_i before reaching the R-line, this t_p/t_i line gives the maximum allowed pulse-energy at the Y-axis. If the applied pulse-energy is known (in Watts) and the impulse-time t_i also, draw a line horizontally from the Y-axis to the crossing with the pulse-line (t_i) and find the possible R-value needed in this application. The horizontal t_p/t_i lines give the maximum allowed pulse-load till they reach the R-line, that point indicates the maximum allowed impulse-time ti at the horizontal axis.

Cemented wirewound resistors AC01/03/04/05/07/10/15/20



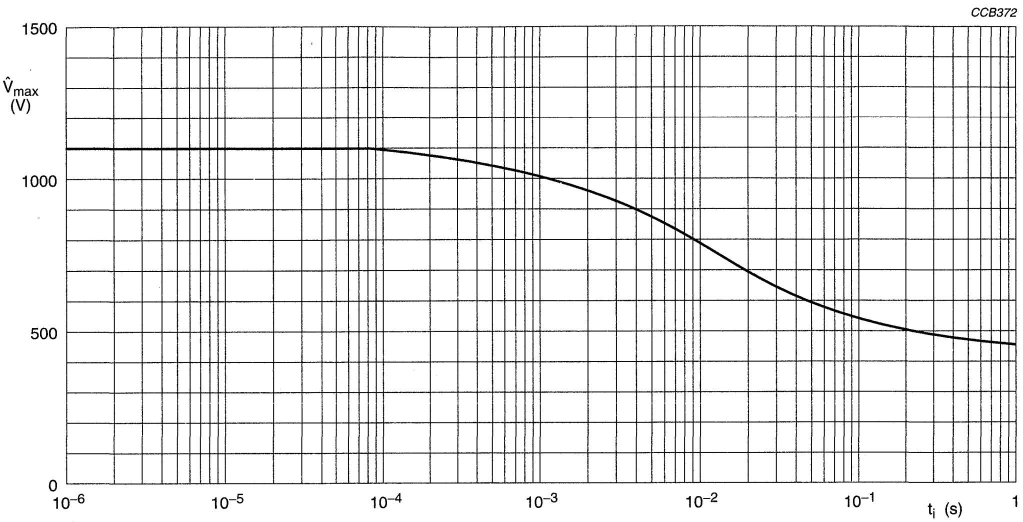
AC01

Fig.2 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



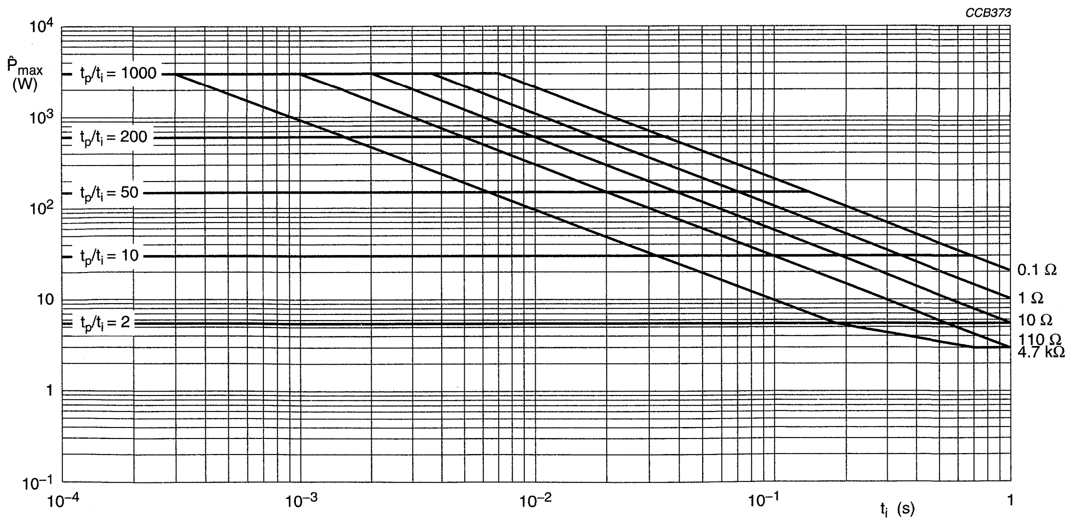
AC01

Fig.3 Pulse capability; W_s as a function of R_n.



AC01

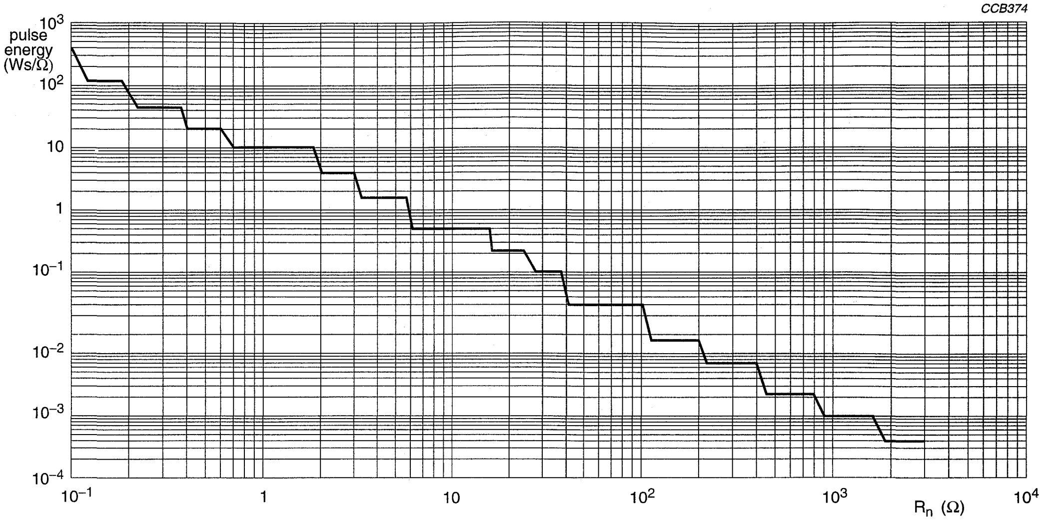
Fig.4 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).



AC03

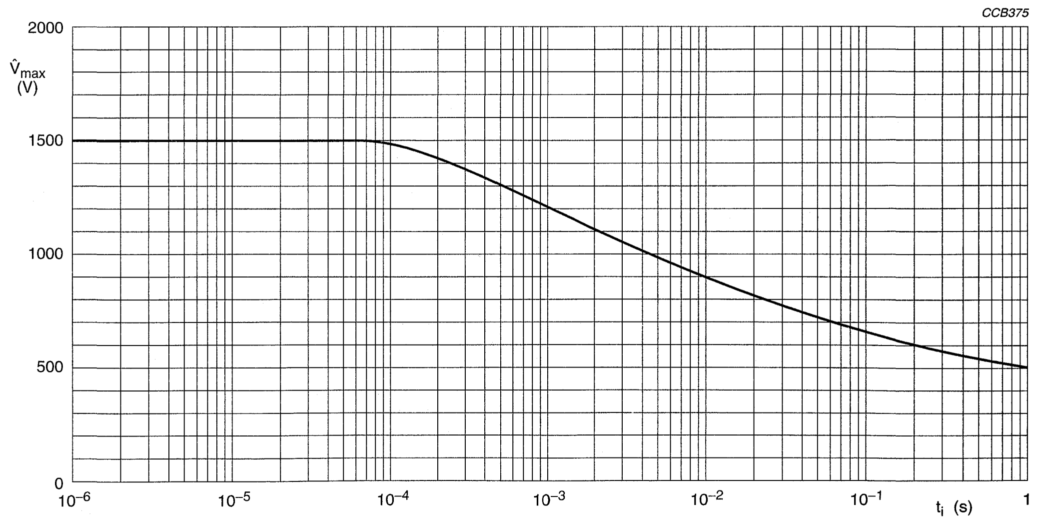
Fig.5 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).

Cemented wirewound resistors AC01/03/04/05/07/10/15/20



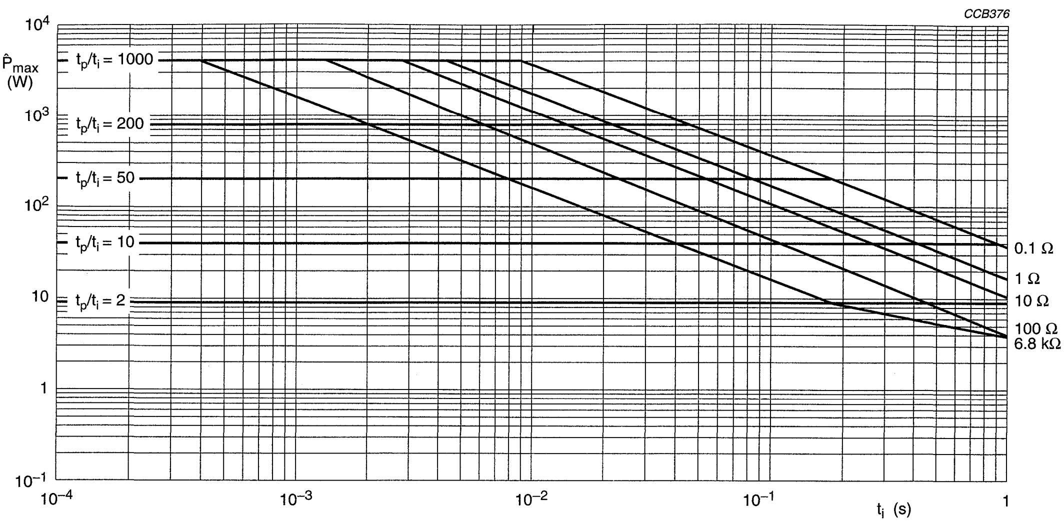
AC03

Fig.6 Pulse capability; W_s as a function of R_n.



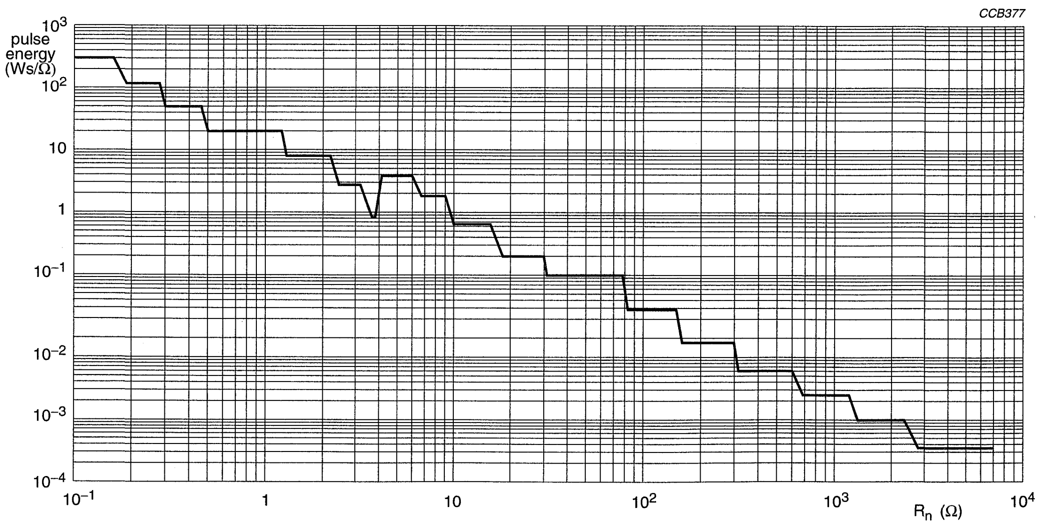
AC03

Fig.7 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).



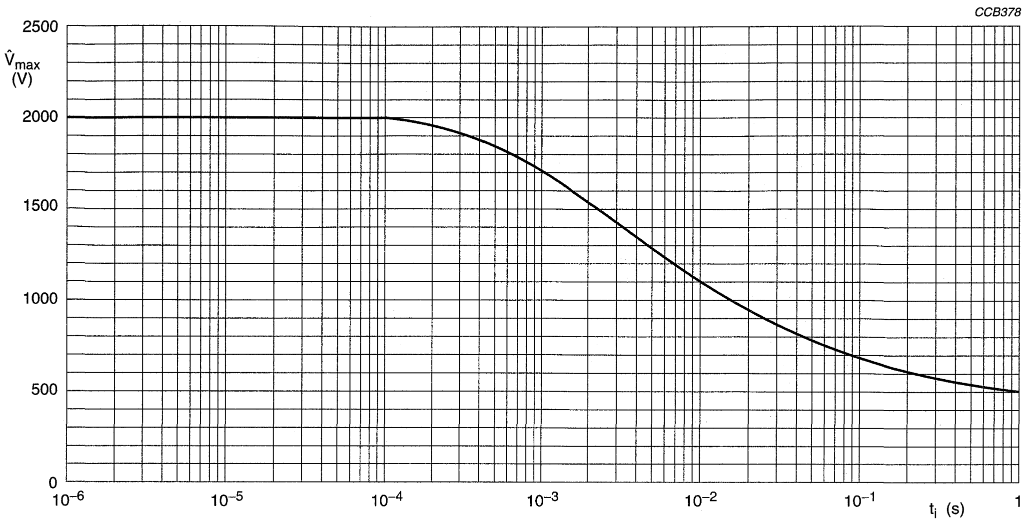
AC04

Fig.8 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



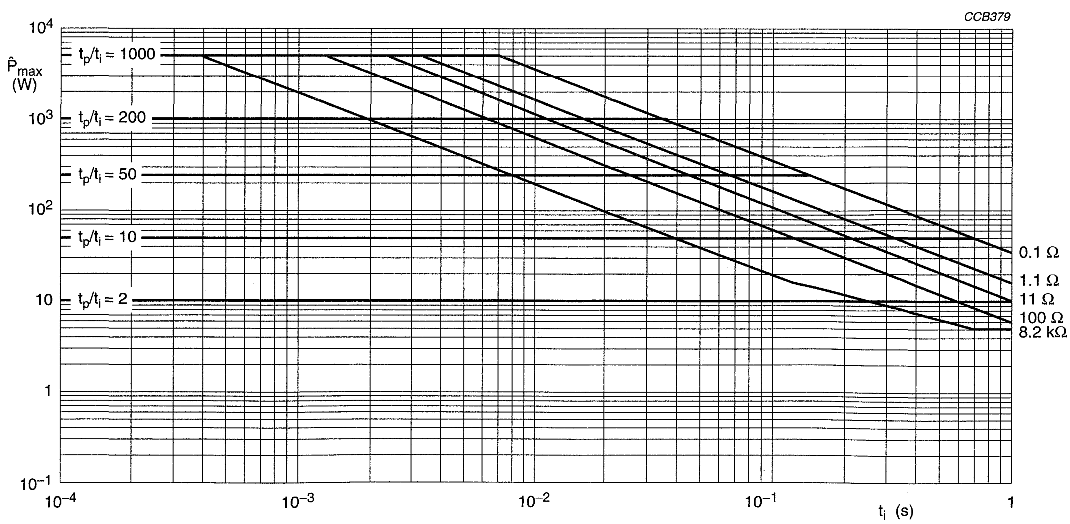
AC04

Fig.9 Pulse capability; W_s as a function of R_n.



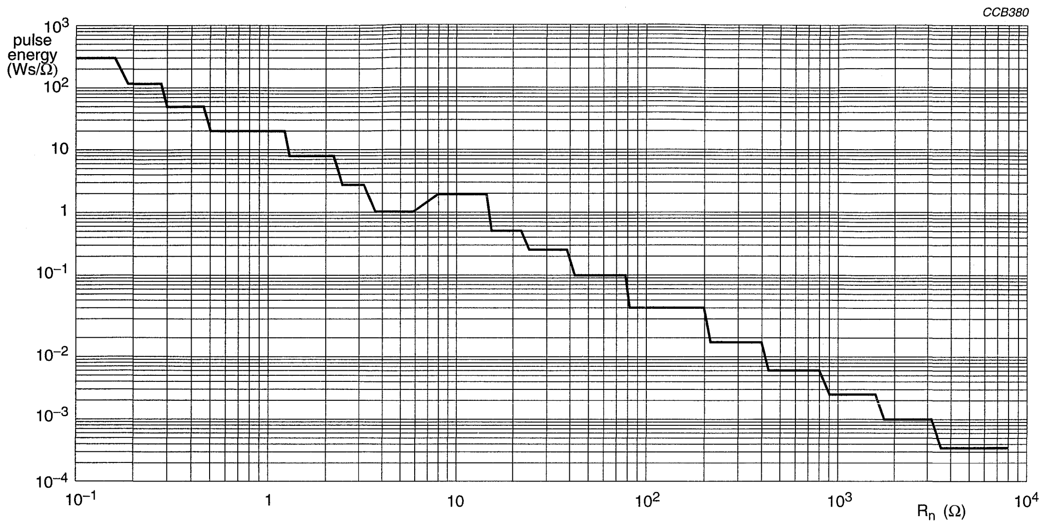
AC04

Fig.10 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).



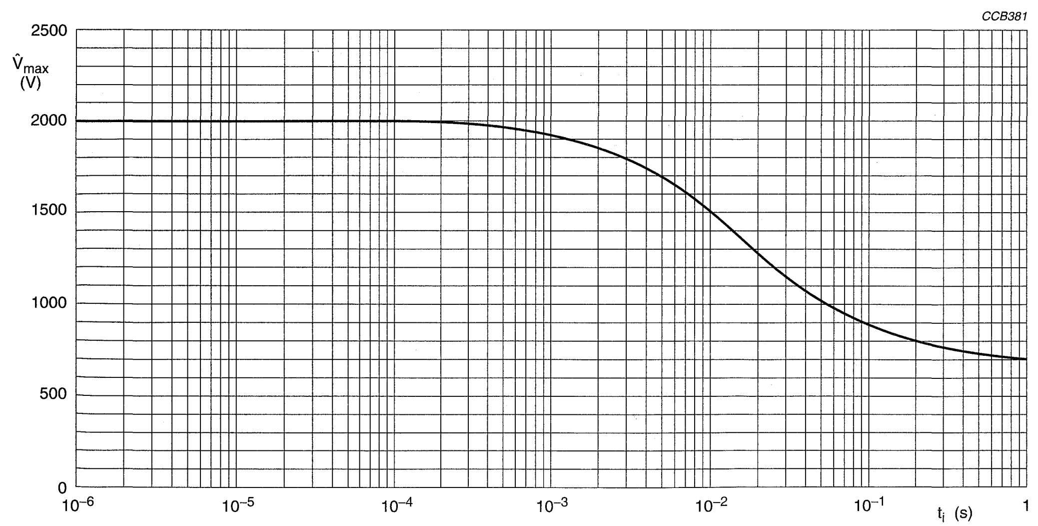
AC05

Fig.11 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



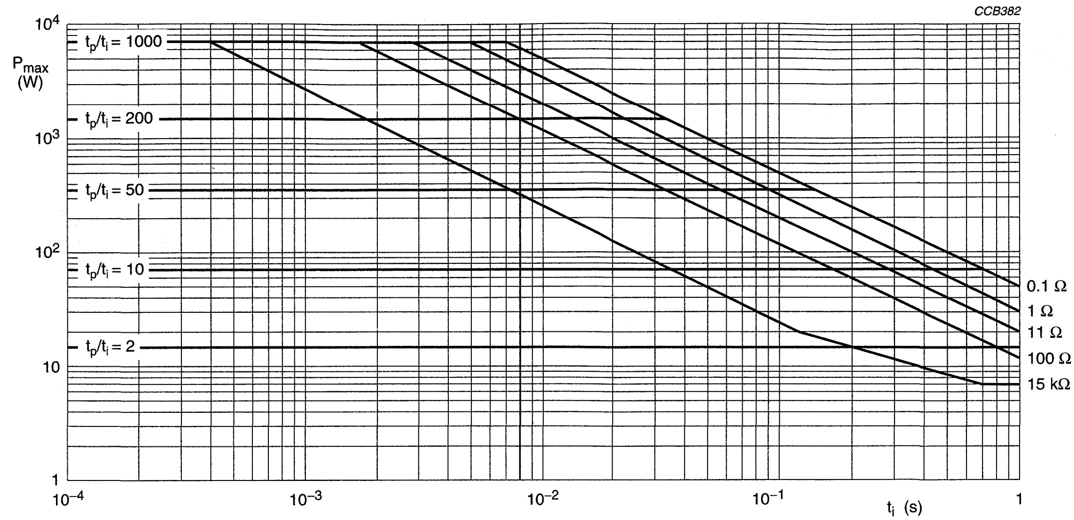
AC05

Fig.12 Pulse capability; W_s as a function of R_n.



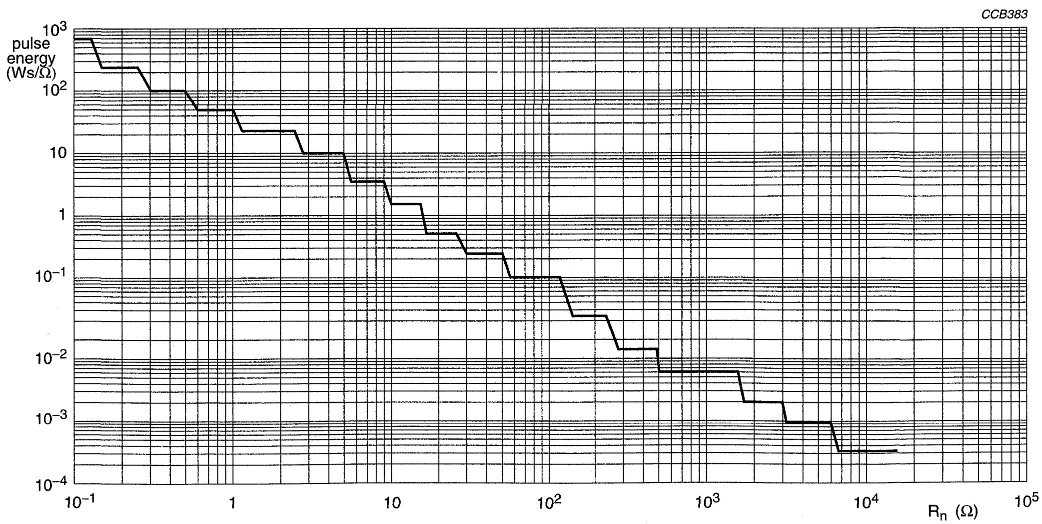
AC05

Fig.13 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).



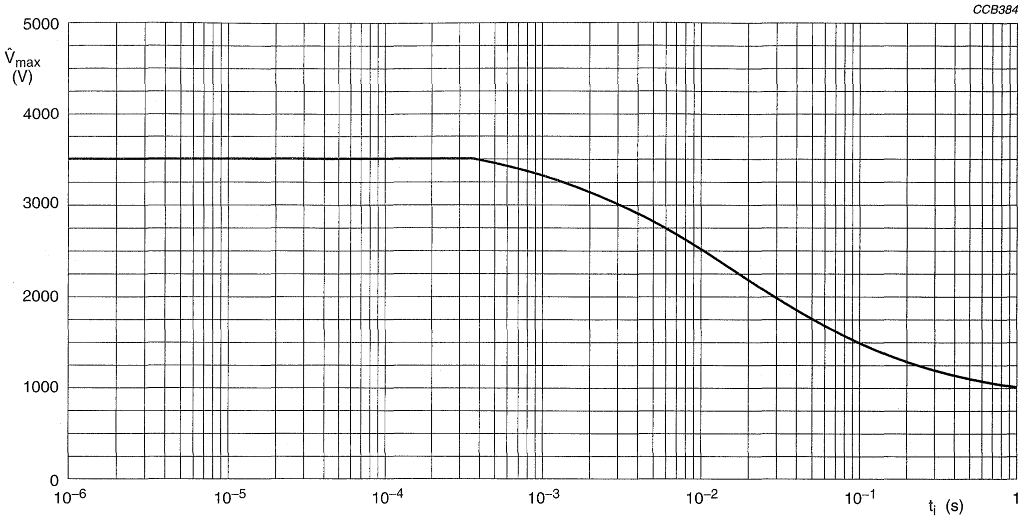
AC07

Fig.14 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



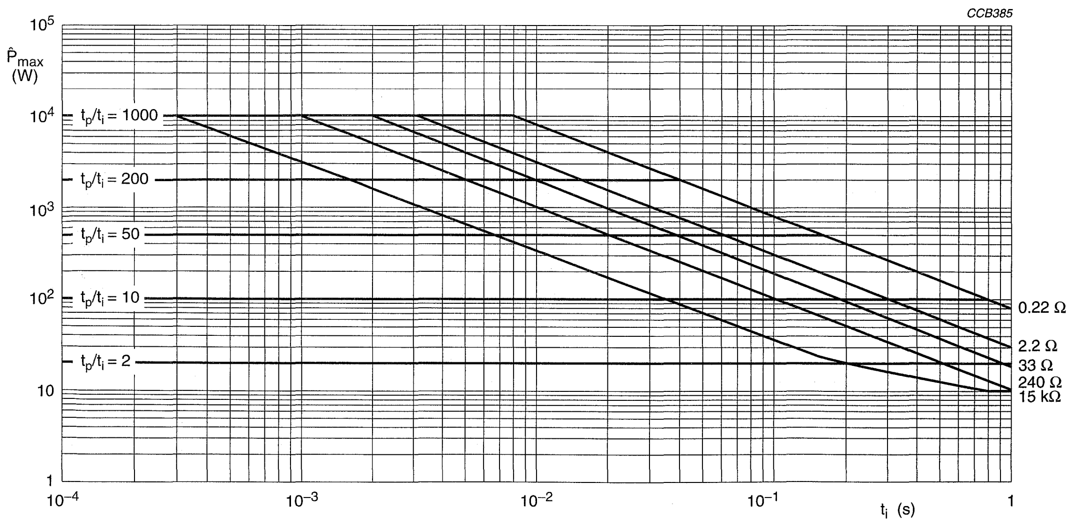
AC07

Fig.15 Pulse capability; W_s as a function of R_n.



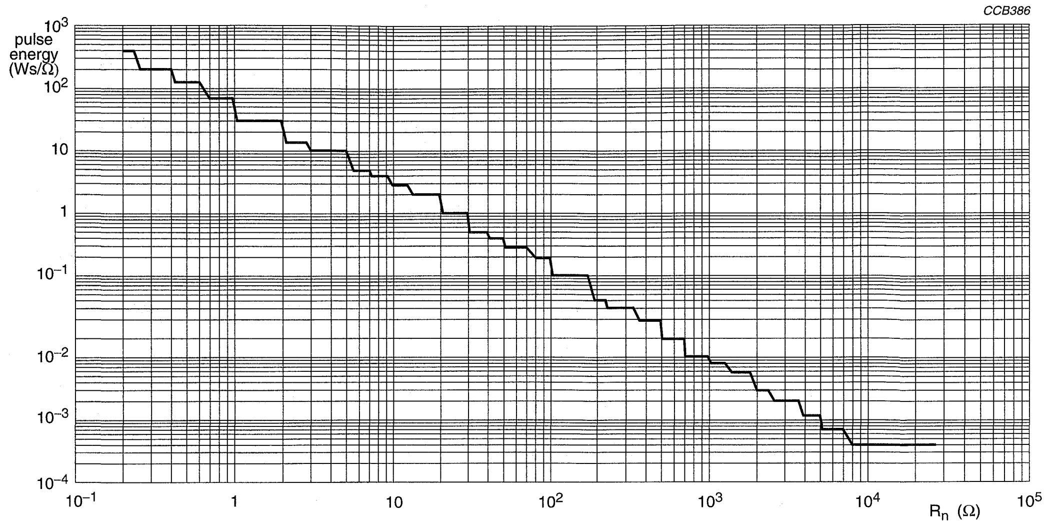
AC07

Fig.16 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).



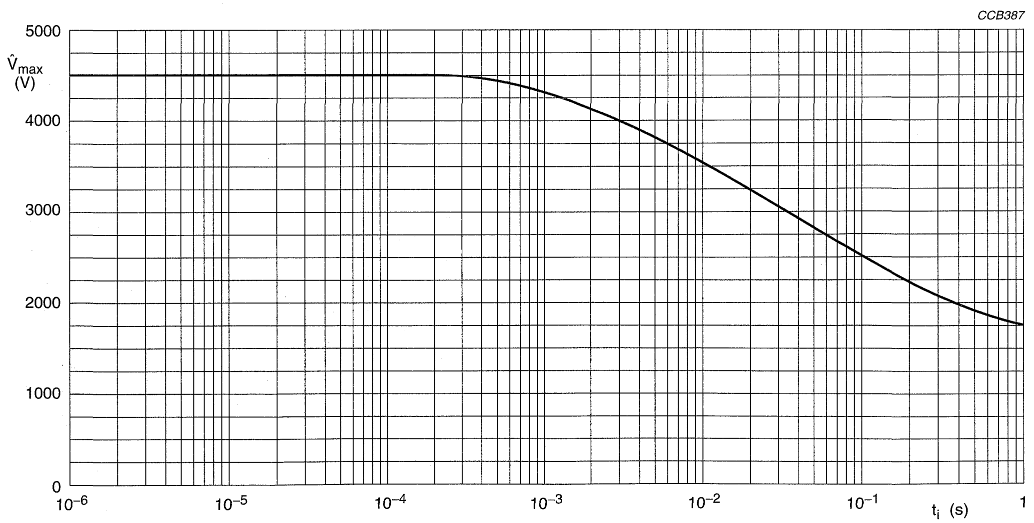
AC10

Fig.17 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



AC10

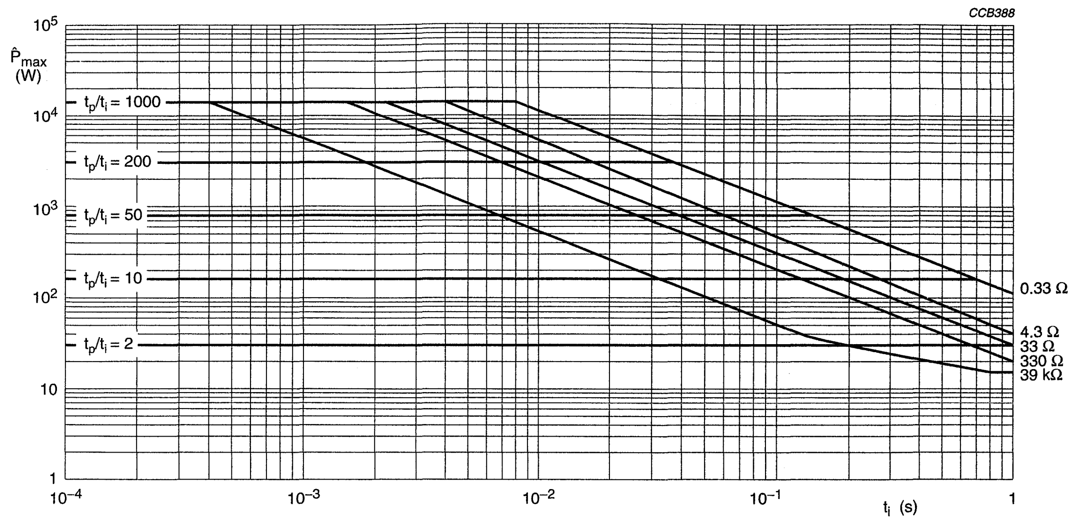
Fig.18 Pulse capability; W_s as a function of R_n.



AC10

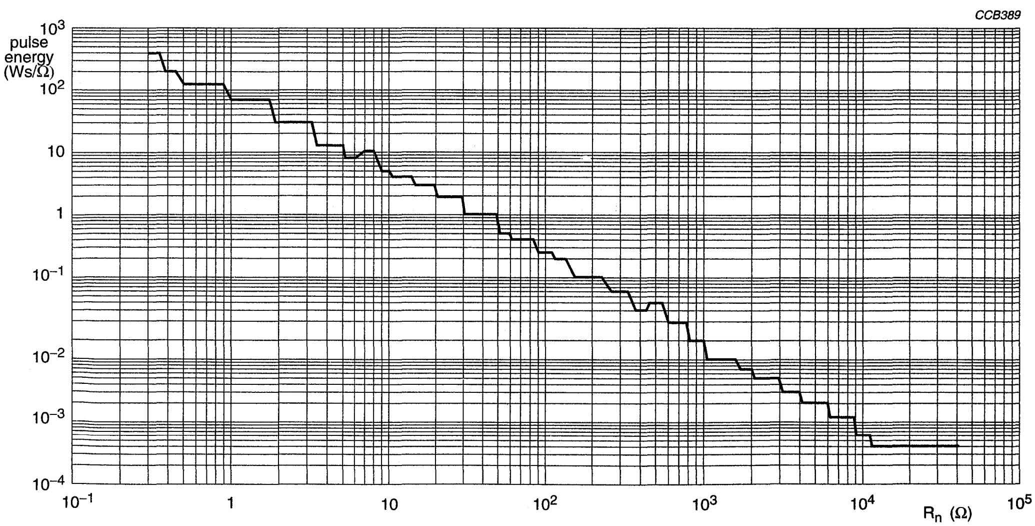
Fig.19 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).

Cemented wirewound resistors AC01/03/04/05/07/10/15/20



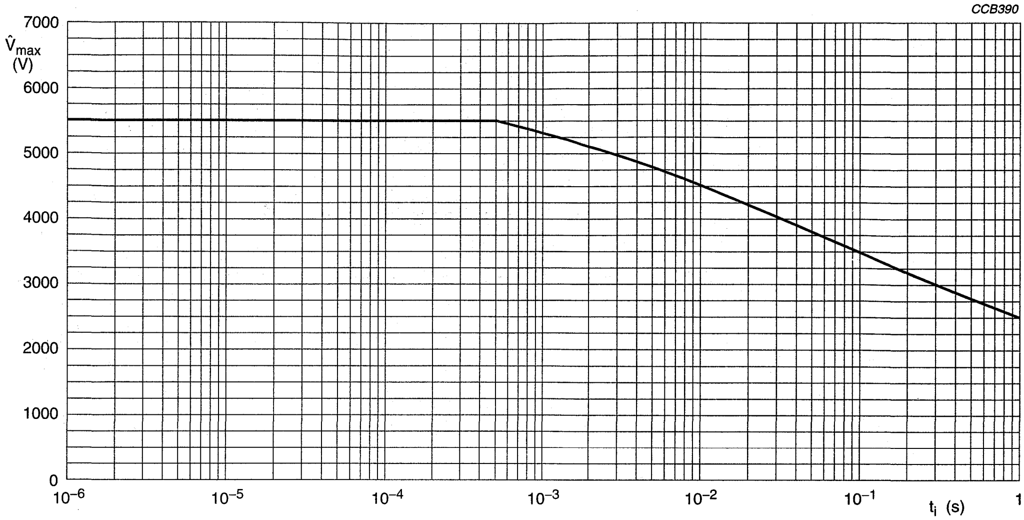
AC15

Fig.20 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



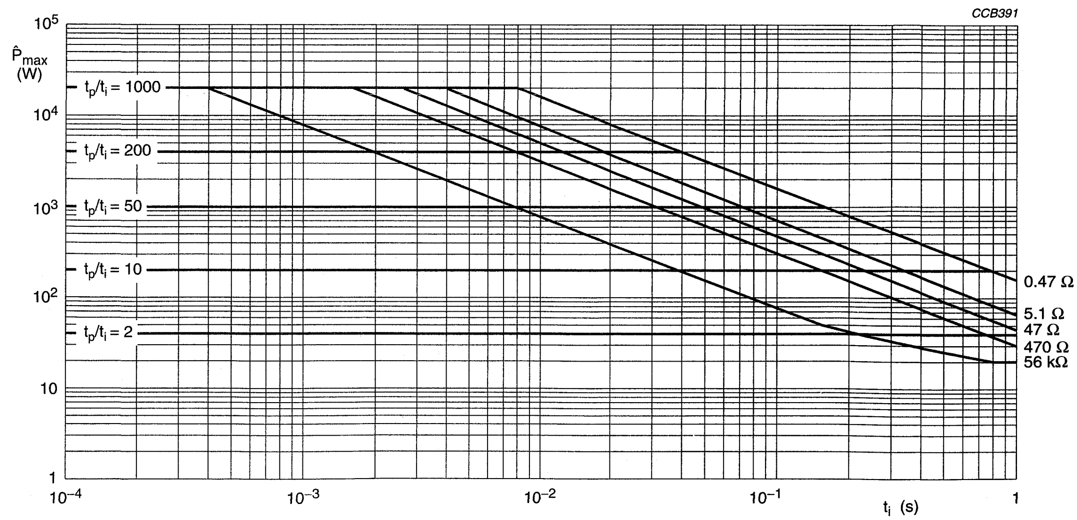
AC15

Fig.21 Pulse capability; W_s as a function of R_n.



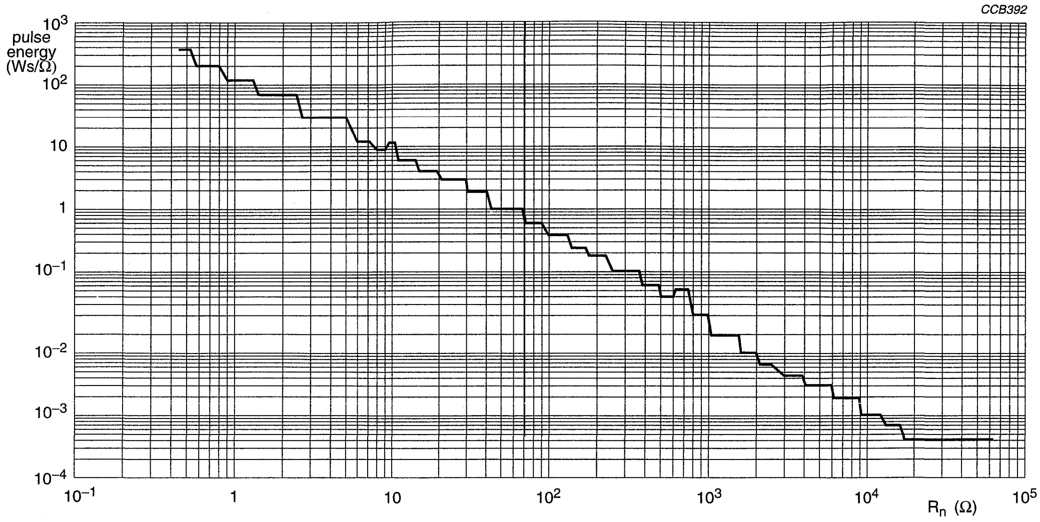
AC15

Fig.22 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).



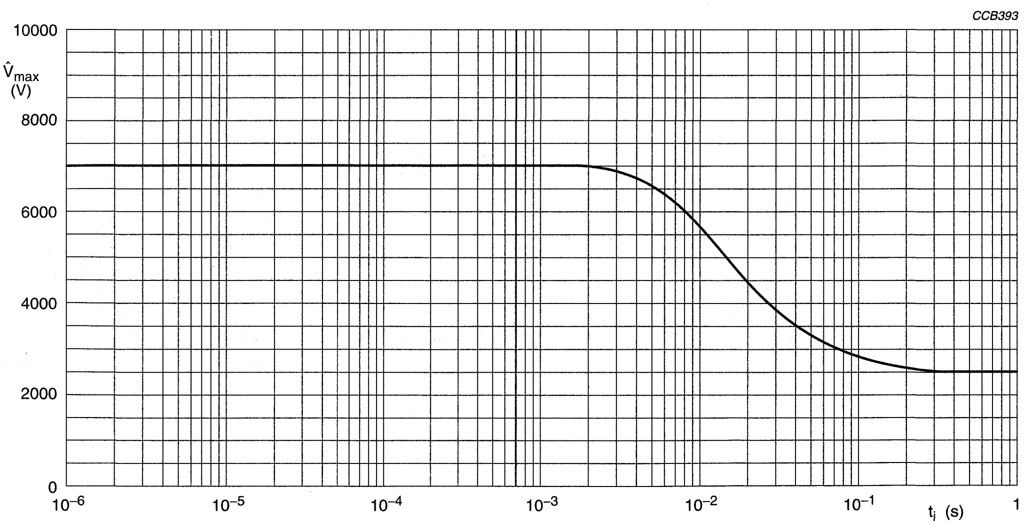
AC20

Fig.23 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



AC20

Fig.24 Pulse capability; W_s as a function of R_n.



AC20

Fig.25 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).

Application information

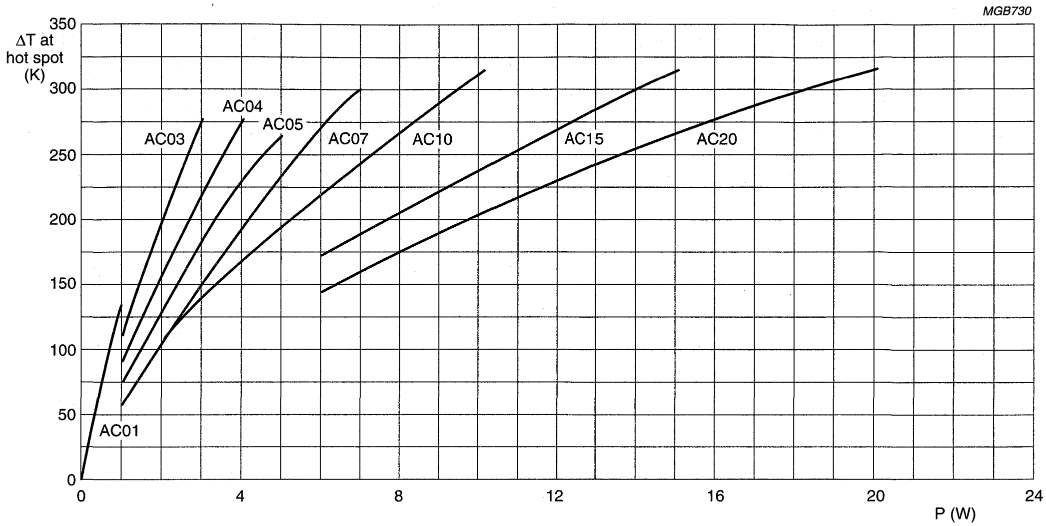
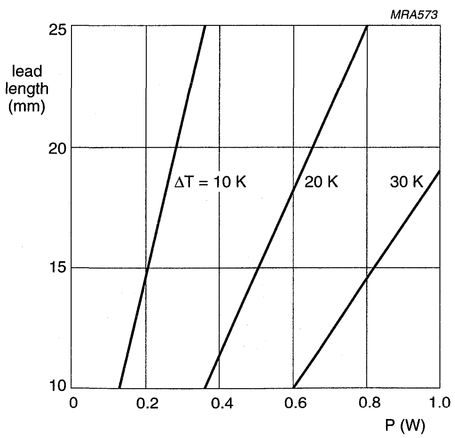
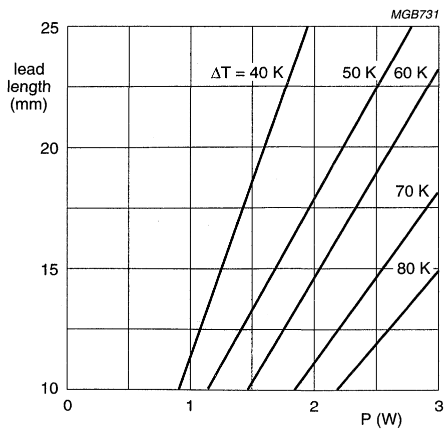


Fig.26 Temperature rise of the resistor body as a function of the dissipation.



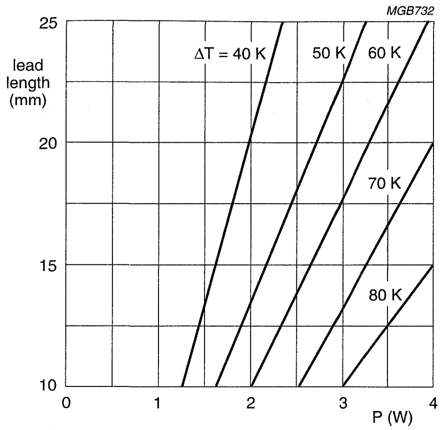
AC01

Fig.27 Lead length as a function of the dissipation with the temperature rise at the end of the lead (soldering spot) as a parameter.



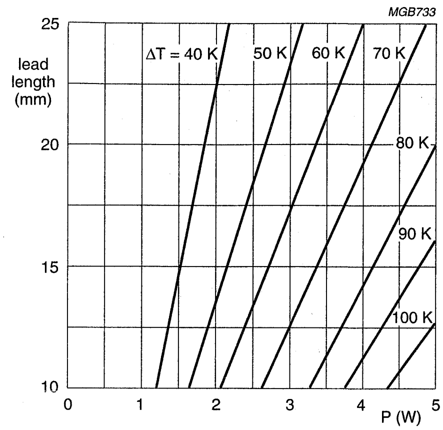
AC03

Fig.28 Lead length as a function of the dissipation with the temperature rise at the end of the lead (soldering spot) as a parameter.



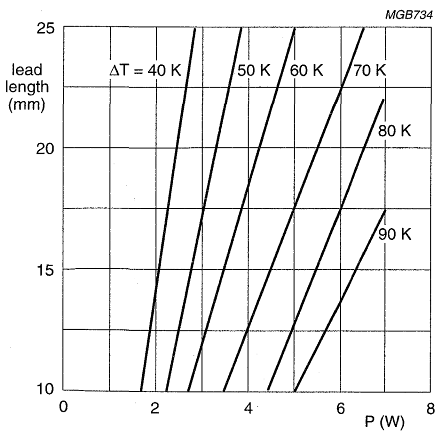
AC04

Fig.29 Lead length as a function of the dissipation with the temperature rise at the end of the lead (soldering spot) as a parameter.



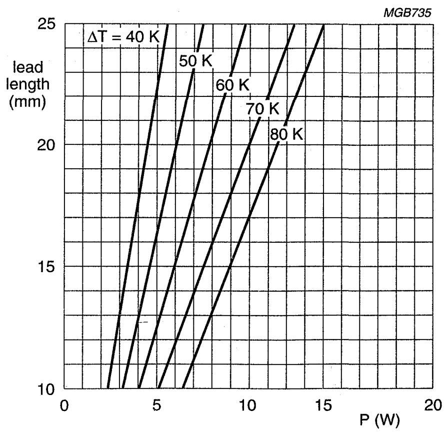
AC05

Fig.30 Lead length as a function of the dissipation with the temperature rise at the end of the lead (soldering spot) as a parameter.



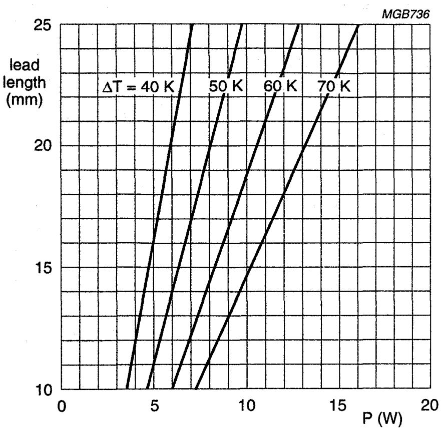
AC07

Fig.31 Lead length as a function of the dissipation with the temperature rise at the end of the lead (soldering spot) as a parameter.



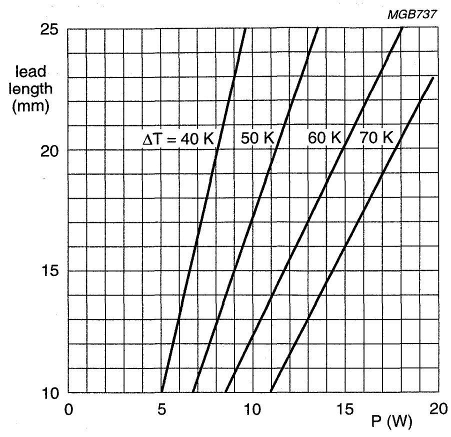
AC10

Fig.32 Lead length as a function of the dissipation with the temperature rise at the end of the lead (soldering spot) as a parameter.



AC15

Fig.33 Lead length as a function of the dissipation with the temperature rise at the end of the lead (soldering spot) as a parameter.



AC20

Fig.34 Lead length as a function of the dissipation with the temperature rise at the end of the lead (soldering spot) as a parameter.

MOUNTING

The resistor is suitable for processing on cutting and bending machines. **Ensure that the temperature rise of the resistor body does not affect nearby components or materials by conducted or convected heat.** Figure 26 shows the hot-spot temperature rise of the resistor body as a function of dissipated power. Figures 27 to 34 show the lead length as a function of dissipated power and temperature rise.

Cemented wirewound resistors AC01/03/04/05/07/10/15/20

MECHANICAL DATA

Mass per 100 units

TYPE	MASS (g)
AC01	55
AC03	110
AC04	140
AC05	220
AC07	300
AC10	530
AC15	840
AC20	1090

Marking

The resistor is marked with the nominal resistance value, the tolerance on the resistance and the rated dissipation at T_{amb} = 40 °C.

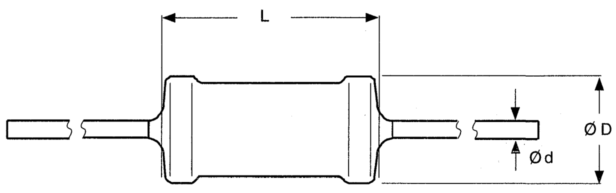
For values up to 910 Ω, the R is used as the decimal point.

For values of 1 kΩ and upwards, the letter K is used as the decimal point for the kΩ indication.

Outlines

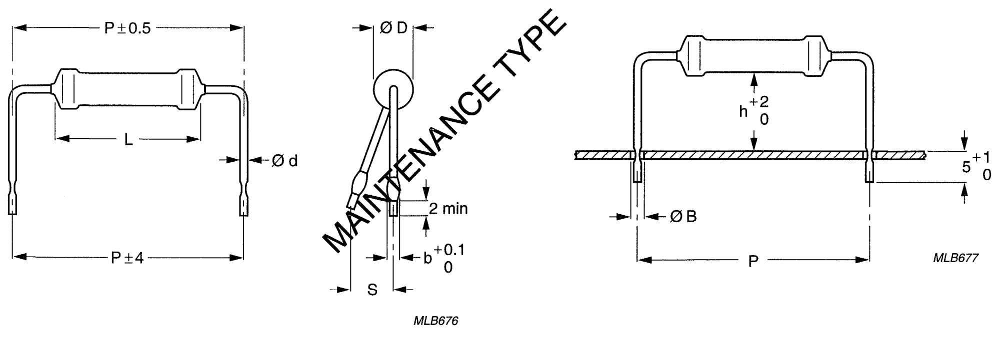
Table 3 Resistor type and relevant physical dimensions; see Figs 35 and 36

<table>
<tr><th>TYPE</th><th>ØD MAX. (mm)</th><th>L MAX. (mm)</th><th>Ød (mm)</th><th>b (mm)</th><th>h (mm)</th><th>P (mm)</th><th>S MAX. (mm)</th><th>ØB MAX. (mm)</th></tr>
<tr><td>AC01</td><td>4.3</td><td>10</td><td rowspan="8">0.8 ±0.03</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>AC03</td><td>5.5</td><td>13</td><td rowspan="4">1.3</td><td rowspan="4">8</td><td rowspan="3">10e</td><td rowspan="4">2</td><td rowspan="4">1.2</td></tr>
<tr><td>AC04</td><td>5.7</td><td>17</td></tr>
<tr><td>AC05</td><td>7.5</td><td>17</td></tr>
<tr><td>AC07</td><td>7.5</td><td>25</td><td>13e</td></tr>
<tr><td>AC10</td><td>8</td><td>44</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>AC15</td><td>10</td><td>51</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>AC20</td><td>10</td><td>67</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
</table>



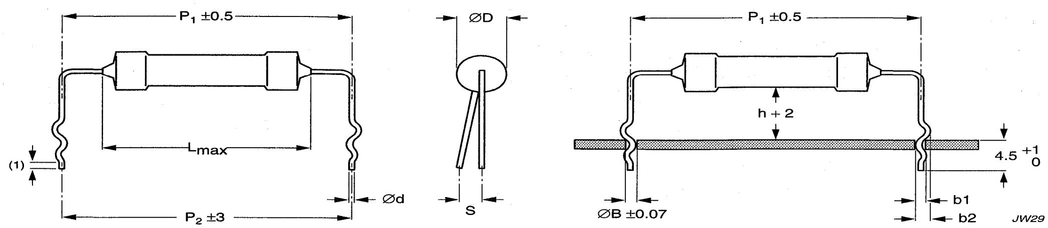
For dimensions see Table 3.

Fig.35 Type with straight leads.



Dimensions in mm.
For dimensions see Table 3.
Available on request for types: **AC03, AC04, AC05 and AC07**.

Fig.36 Type with cropped and formed leads.



Dimensions in mm.
For dimensions see Table 4.
Ø0.8 to 1.4.

Fig.37 Type with double kink.

Table 4 Resistor type and relevant physical dimensions; see Fig.37

TYPE	LEAD STYLE	ØD (mm)	L MAX. (mm)	b_1 (mm)	b_2 (mm)	h (mm)	P_1 (mm)	P_2 (mm)	S MAX. (mm)	ØB (mm)
AC03 AC04 AC05	double kink large pitch	0.8 ±0.03	10	1.30 +0.25/-0.20	1.65 +0.25/-0.20	8	25.4	25.4	2	1.0
AC03 AC04 AC05	double kink small pitch	0.8 ±0.03	10	1.30 +0.25/-0.20	2.15 +0.25/-0.20	8	22.0	20.0	2	1.0

Cemented wirewound resistors AC01/03/04/05/07/10/15/20

TESTS AND REQUIREMENTS

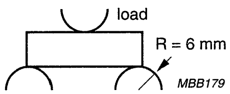
Essentially all tests are carried out in accordance with the schedule of *"IEC publications 60115-1 and 60115-4"*, category 40/200/56 (rated temperature range −40 °C to +200 °C; damp heat, long term, 56 days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 60068, *"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 Table 5 the tests and requirements are listed with reference to the relevant clauses of *"IEC publications 60115-1, 115-4 and 68"*; 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.

Table 5 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
Tests in accordance with the schedule of IEC publication 60115-1				
4.15		robustness of resistor body	load 200 ±10 N 	no visible damage ΔR/R max.: ±0.5% + 0.05 Ω
4.16	U	robustness of terminations:		
	Ua	tensile all samples	load 10 N; 10 s	
	Ub	bending half number of samples	load 5 N 90°, 180°, 90°	
	Uc	torsion other half of samples	2 × 180° in opposite directions	no visible damage ΔR/R max.: ±0.5% + 0.05 Ω
4.17	Ta	solderability	2 s; 235 °C; flux 600	good tinning; no damage
4.18	Tb	resistance to soldering heat	thermal shock: 3 s; 350 °C; 2.5 mm from body	ΔR/R max.: ±0.5% + 0.05 Ω
4.19	14 (Na)	rapid change of temperature	30 minutes at −40 °C and 30 minutes at +200 °C; 5 cycles	no visible damage ΔR/R max.: ±1% + 0.05 Ω
4.22	Fc	vibration	frequency 10 to 500 Hz; displacement 0.75 mm or acceleration 10 g; 3 directions; total 6 hours (3 × 2 hours)	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.20	Eb	bump	4000 ±10 bumps; 390 m/s^2	no damage ΔR/R max.: ±0.5% + 0.05 Ω

IEC 60115-1 CLAUSE	IEC 60068 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.23		climatic sequence:		
4.23.2	Ba	dry heat	16 hours; 200 °C	
4.23.3	Db	damp heat (accelerated) 1st cycle	24 hours; 55 °C; 95 to 100% RH	
4.23.4	Aa	cold	2 hours; −40 °C	
4.23.5	M	low air pressure	1 hour; 8.5 kPa; 15 to 35 °C	
4.23.6	Db	damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 to 100% RH	ΔR/R max.: ±1% + 0.05 Ω
4.24.2	3 (Ca)	damp heat (steady state)	56 days; 40 °C; 90 to 95% RH; dissipation ≤0.01 P_n	no visible damage ΔR/R max.: ±1% + 0.05 Ω
4.8.4.2		temperature coefficient	at 20/−40/20 °C, 20/200/20 °C: R < 10 Ω R ≥ 10 Ω	 TC ≤ ±600 × 10^{-6}/K −80 × 10^{-6} ≤ TC TC ≤ +140 × 10^{-6}/K
		temperature rise	horizontally mounted, loaded with P_n	hot-spot temperature less than maximum body temperature
4.13		short time overload	room temperature; dissipation 10 × P_n; 5 s (voltage not more than 1000 V/25 mm)	ΔR/R max.: ±2% + 0.1 Ω
4.25.1		endurance (at 40 °C)	1000 hours loaded with P_n; 1.5 hours on and 0.5 hours off	no visible damage ΔR/R max.: ±5% + 0.1 Ω
4.25.1		endurance (at 70 °C)	1000 hours loaded with $0.9P_n$; 1.5 hours on and 0.5 hours off	no visible damage ΔR/R max.: ±5% + 0.1 Ω
4.23.2	27 (Ba)	endurance at upper category temperature	1000 hours; 200 °C; no load	no visible damage ΔR/R max.: ±5% + 0.1 Ω
Other tests in accordance with IEC 60115 clauses and IEC 60068 test method				
4.29	45 (Xa)	component solvent resistance	70% 1.1.2 trichlorotrifluoroethane and 30% isopropyl alcohol; H_20	no visible damage
4.18	20 (Tb)	resistance to soldering heat	10 s; 260 ±5 °C; flux 600	ΔR/R max.: ±0.5% + 0.05 Ω
4.17	20 (Tb)	solderability (after ageing)	16 hours steam or 16 hours at 155 °C; 2 ±0.5 s in solder at 235 ±5 °C; flux 600	good tinning (≥95% covered); no damage
4.5		tolerance on resistance	applied voltage (±10%): R < 10 Ω: 0.1 V 10 Ω ≤ R < 100 Ω: 0.3 V 100 Ω ≤ R < 1 kΩ: 1 V 1 kΩ ≤ R < 10 kΩ: 3 V 10 kΩ ≤ R ≤ 33 kΩ: 10 V	R − R_{nom}: ±5% max.

Stand-up miniature power resistors

SMW02/03/05
SMF02/03/05

FEATURES

- High power dissipation in small volume
- High pulse load handling capabilities
- 2e pitch mounting
- Designed in stand-up configuration for stand-up mounting.

APPLICATIONS

- Ballast switching
- Power supplies
- Shunts.

DESCRIPTION

SMW: The resistor element is a resistive wire which is wound in a single layer on a ceramic rod. Metal caps are pressed over the ends of the rod. The ends of the resistance wire and the leads are connected to the caps by welding.

SMF: The resistor element is a metal film resistor consisting of a metal layer deposited over a high grade ceramic rod. The resistive film is adjusted to final value by means of a helical groove. The leads are connected to the caps by welding.

SMW/SMF: Tinned copper-clad iron leads with poor heat conductivity are employed permitting the use of relatively short leads to obtain stable mounting without overheating the solder joint.

The resistor body and lead ends are housed within a rectangular ceramic case which is non-flammable, will not melt even at high overloads and is resistant to most commonly used cleaning solvents, in accordance with *"MIL-STD-202E, method 215"* and *"IEC 60068-2-45"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE					
	SMW02	SMF02	SMW03	SMF03	SMW05	SMF05
Resistance range; note 1	0.1 to 200 Ω	220 Ω to 47 kΩ	0.1 to 560 Ω	620 Ω to 47 kΩ	0.1 to 560 Ω	620 Ω to 47 kΩ
Resistance tolerance	±5%; E24 series					
Maximum permissible body temperature	300 °C					
Rated dissipation at T_{amb} = 70 °C	2 W		3 W		5 W	
Climatic category (IEC 60068)	40/200/56					
Basic specification	IEC 60115-1					
Stability after:						
load, 1 000 hours	ΔR/R max.: ±5% + 0.1 Ω					
climatic tests	ΔR/R max.: ±3% + 0.1 Ω					
short time overload	ΔR/R max.: ±2% + 0.1 Ω					
Insulation voltage	>2 000 V					

Note

1. Higher values are available on request.

ORDERING INFORMATION

Table 1 Ordering code indicating resistor type and packaging

TYPE	ORDERING CODE 2306 34. .....
	LOOSE IN BOX
	500 units
SMW02	0 03...
SMF02	5 03...
SMW03	1 03...
SMF03	6 03...
SMW05	2 03...
SMF05	7 03...

Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2306 34
- The subsequent 3 digits indicate the resistor type and packaging; see Table 1.
- The remaining 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 2.

Table 2 Last digit of 12NC

RESISTANCE DECADE	LAST DIGIT
0.1 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 47 kΩ	3

ORDERING EXAMPLE

The ordering code of a SMW02 resistor, value 47 Ω, supplied loose in box of 500 units is: 2306 340 03479.

Stand-up miniature power resistors

SMW02/03/05 SMF02/03/05

FUNCTIONAL DESCRIPTION

Product characterization

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

Limiting values

TYPE	LIMITING VOLTAGE(1) (V)	LIMITING POWER (W)
SMW02	$V = \sqrt{P_n \times R}$	2
SMF02	350	
SMW03	$V = \sqrt{P_n \times R}$	3
SMF03	350	
SMW05	$V = \sqrt{P_n \times R}$	5
SMF05	600	

Note

1. The maximum voltage that may be continuously applied to the resistor element, see *"IEC publication 60266"*.

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.1.

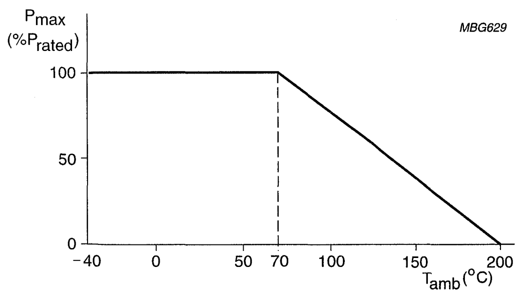


Fig.1 Maximum dissipation (P_{max}) as a function of the ambient temperature (T_{amb}).

The maximum permissible hot-spot temperature is 300 °C, and the minimum breakdown voltage of the encapsulation is 2000 V.

PULSE LOADING CAPABILITY

Detailed pulse loading information is available on request.

Application information

MOUNTING

The resistors must be mounted in such a way that no stress is exerted on the leads and that thermal expansion is possible over the temperature range. **Ensure that the temperature rise of the resistor body by conducted or convected heat, does not affect nearby components or materials.** The temperature rise at the soldering point of the leads must not reach the melting point of the solder. The temperature rise at the soldering point as a function of dissipated power is shown in Fig.2.

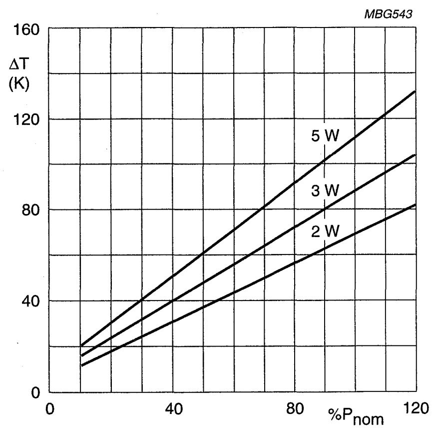


Fig.2 Solder spot temperature rise (ΔT) as a function of dissipated power.

Stand-up miniature power resistors

SMW02/03/05 SMF02/03/05

MECHANICAL DATA

Mass per 100 units

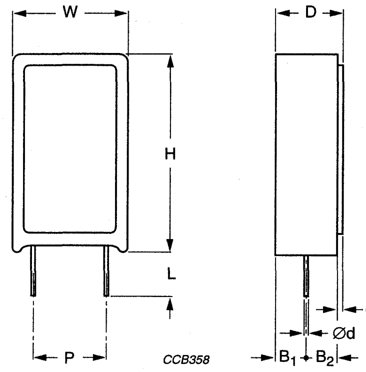
TYPE	MASS (g)
SMW02	370
SMF02	
SMW03	530
SMF03	
SMW05	640
SMF05	

Marking

The resistor is marked with the resistor type designation, the production week, nominal resistance value, the tolerance on the resistance and the rated dissipation at T_{amb} = 70 °C.

For values up to 910 Ω the R is used as a decimal point. For values of 1 kΩ or greater the letter K is used as the decimal point for the kΩ indication.

Outlines



For dimensions see Table 3.

Fig.3 Outlines.

Table 3 Resistor type and relevant physical dimensions; see Fig.3

TYPE	W (mm)	D (mm)	C (mm)	H (mm)	¢$B_1 - B_2$¢ (mm)	L (mm)	P (mm)	Ød (mm)
SMW02	11 ±1	7 ±1	0/+1.0	20.5 ±1.5	+0.9/–0.3	4.5 ±1.5	5 ±1	0.8 ±0.03
SMF02								
SMW03	12 ±1	8 ±1	0/+1.0	25.0 ±1.5	+1.4/–0.3			
SMF03								
SMW05	13 ±1	9 ±1	0/+1.0	25.5 ±1.5	+2.3/–0.3			
SMF05								

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of *"IEC publications 60115-1 and 60115-4"*, category 40/200/56 (rated temperature range –40 °C to +200 °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, *"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 Table 4 the tests and requirements are listed with reference to the relevant clauses of *"IEC publications 60115-1, 60115-4 and 68"*; 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.

Table 4 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
Tests in accordance with the schedule of IEC publication 60115-1				
4.15		robustness of resistor body	load 200 ±10 N	no visible damage ΔR/R max.: ±0.5% + 0.05 Ω
4.16	U	robustness of terminations:		
	Ua	tensile all samples	load 10 N; 10 s	no visible damage ΔR/R max.: ±0.5% + 0.05 Ω
4.17	Ta	solderability	2 s; 235 °C; flux 600	good tinning; no damage
4.18	Tb	resistance to soldering heat	thermal shock: 3 s; 350 °C; 2.5 mm from body	ΔR/R max.: ±0.5% + 0.05 Ω
4.19	14 (Na)	rapid change of temperature	30 minutes at –40 °C and 30 minutes at +200 °C; 5 cycles	no visible damage ΔR/R max.: ±1% + 0.05 Ω
4.22	Fc	vibration	frequency 10 to 500 Hz; displacement 0.75 mm or acceleration 10 g; 3 directions; total 6 hours (3 × 2 hours)	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.20	Eb	bump	4000 ±10 bumps; 390 m/s^2	no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.23		climatic sequence:		
4.23.2	Ba	dry heat	16 hours; 200 °C	
4.23.3	Db	damp heat (accelerated) 1st cycle	24 hours; 55 °C; 95 to 100% RH	
4.23.4	Aa	cold	2 hours; –40 °C	
4.23.5	M	low air pressure	1 hour; 8.5 kPa; 15 to 35 °C	
4.23.6	Db	damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 to 100% RH	ΔR/R max.: ±3% + 0.05 Ω

IEC 60115-1 CLAUSE	IEC 60068 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	no visible damage ΔR/R max.: ±3% + 0.1 Ω
4.8.4.2		temperature coefficient	at 20/–40/20 °C, 20/200/20 °C: **SMW**: R < 10 Ω **SMW**: R ≥ 10 Ω **SMF**	 TC ≤ ±600 × 10^{-6}/K $-80 \times 10^{-6} \leq$ TC ≤ +140 × 10^{-6}/K TC ≤ +250 × 10^{-6}/K
4.13		short time overload	room temperature; dissipation 10 × P_n; 5 s O(voltage not more than 1 000 V/25 mm)	ΔR/R max.: ±2% + 0.1 Ω
4.25.1		endurance (at 70 °C)	1 000 hours loaded with 0.9 P_n; 1.5 hours on and 0.5 hours off	no visible damage ΔR/R max.: ±5% + 0.1 Ω
4.23.2	Ba	endurance at upper category temperature	1 000 hours; 200 °C; no load	no visible damage ΔR/R max.: ±5% + 0.1 Ω

Radial mounted power resistors

FEATURES

- High power dissipation in small volume
- Low solder spot temperature
- Very stable mounting
- Fire-proof inorganic construction.

APPLICATIONS

- These resistors have been designed to dissipate high powers in a small volume, to be used in applications where low solder spot temperature and very stable mounting are essential
- Specially designed for inrush current limitation of line connected power supplies, as the input stage of television power supplies and wherever a save fuse feature is required in case of a short circuit fault; see Fig.1.

DESCRIPTION

RMW: The resistor element is a resistive wire which is wound in a single layer on a fibre glass core.

RMF: The resistor element is a metal film resistor consisting of a metal layer deposited over a high grade ceramic rod. The resistive film is adjusted to final value by means of a helical groove.

RMW/RMF: The mounting terminations are crimped to the resistive body to assure a good mechanical and electrical contact.

The resistor body and lead ends are housed within a rectangular ceramic case which is non-flammable, will not melt even at high overloads and is resistant to most commonly used cleaning solvents, in accordance with *"IEC 60068-2-45"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE							
	RMW03	RMF03	RMW05	RMF05	RMW07	RMF07	RMW10	RMF10
Resistance tolerance, type and range (E24 series):								
±10%	0.22 to 1.5 Ω	–	0.47 to 1.5 Ω	–	0.47 to 1.5 Ω	1 k to 100 kΩ	0.47 to 1.5 Ω	1 k to 150 kΩ
±5%	1.6 Ω to 3.9 kΩ	100 Ω to 39 kΩ	1.6 Ω to 4.7 kΩ	100 Ω to 51 kΩ	1.6 Ω to 7.5 kΩ	–	1.6 Ω to 10 kΩ	–
Maximum permissible body temperature	275 °C							
Rated dissipation at T_{amb} = 70 °C	3 W		5 W		7 W		10 W	
Climatic category (IEC 60068)	25/155/56							
Basic specification	IEC 60115-1							
Stability after:								
load, 1000 hours	ΔR/R max.: ±5% + 0.1 Ω							
climatic tests	ΔR/R max.: ±1% + 0.1 Ω							
short time overload	ΔR/R max.: ±2% + 0.1 Ω							
Insulation voltage	>2000 V							

Radial mounted power resistors

RMW03/05/07/10 RMF03/05/07/10

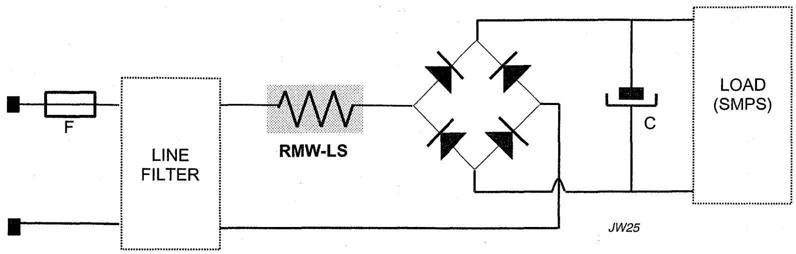


Fig.1 Typical application circuit.

ORDERING INFORMATION

Table 1 Ordering code indicating resistor type; style and length of termination

TYPE	ORDERING CODE 23..					
	TERMINATION STYLE 1			TERMINATION STYLE 2		PACKAGING
	lead length 10 mm	lead length 25 mm	lead length 30 mm	lead length 10 mm	lead length 25 mm	LOOSE IN BOX (units per box)
RMW03	22 250 11...	22 250 12...	–	22 250 21...	22 250 22...	500
RMF03	22 256 11...	22 256 12...	–	22 256 21...	22 256 22...	500
RMW05	22 251 11...	22 251 12...	–	22 251 21...	22 251 22...	500
RMF05	22 257 11...	22 257 12...	–	22 257 21...	22 257 22...	500
RMW07	22 252 11...	22 252 12...	–	22 252 21...	22 252 22...	500
RMF07	22 258 11...	22 258 12...	–	22 258 21...	22 258 22...	500
RMW10	22 253 11...	22 253 12...	–	22 253 21...	22 253 22...	400
RMF10	22 259 11...	22 259 12...	–	22 259 21...	22 259 22...	400

Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2322 25 or 2306 25
- The subsequent 3 digits indicate the resistor type, termination style and length; see Table 1.
- The remaining 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 2.

Table 2 Last digit of 12NC

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 91 kΩ	3
100 to 150 kΩ	4

ORDERING EXAMPLE

The ordering code of an RMW03 resistor, value 47 Ω, with standard terminations, style 1 and length 10 mm, supplied loose in box of 500 units is: 2322 250 11479.

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E24 series for resistors with a tolerance of ±5% or ±10%. The values of the E24 series are in accordance with *"IEC publication 60063"*.

Limiting values

TYPE	LIMITING VOLTAGE[1] (V)	LIMITING POWER (W)
RMW03	$V = \sqrt{P_n \times R}$	3
RMF03	750	
RMW05	$V = \sqrt{P_n \times R}$	5
RMF05	1 000	
RMW07	$V = \sqrt{P_n \times R}$	7
RMF07	1200	
RMW10	$V = \sqrt{P_n \times R}$	10
RMF10	1500	

Note

1. The maximum voltage that may be continuously applied to the resistor element, see *"IEC publication 60266"*.

Application information

MOUNTING

The resistors must be mounted in such a way that no stress is exerted on the leads and that thermal expansion is possible over the temperature range. **Ensure that the temperature rise of the resistor body by conducted or convected heat, does not affect nearby components or materials.** The temperature rise at the soldering point of the leads must not reach the melting point of the solder. The temperature rise at the soldering point and the hot-spot as a function of dissipated power for the various types, are shown in Figs 4, 5, 6 and 7.

The maximum permissible hot-spot temperature is 275 °C, and the minimum breakdown voltage of the encapsulation is 2000 V.

PULSE LOADING CAPABILITY

Detailed pulse loading information is available on request.

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.2.

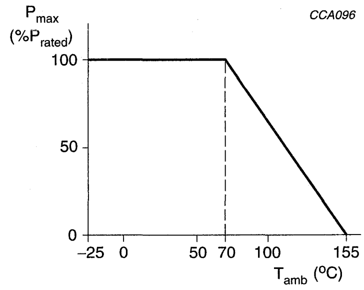


Fig.2 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

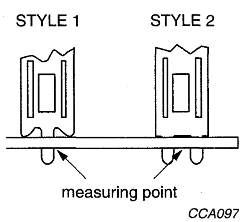
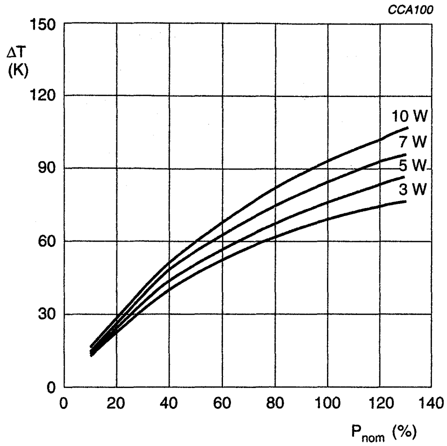


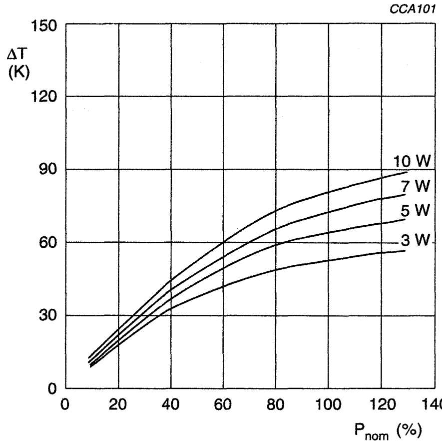
Fig.3 Measuring point of the solder spot temperature.

TEMPERATURE RISE OF SOLDER SPOT AND HOT-SPOT AS A FUNCTION OF LOAD AND LEAD LENGTH FOR STYLES 1 AND 2



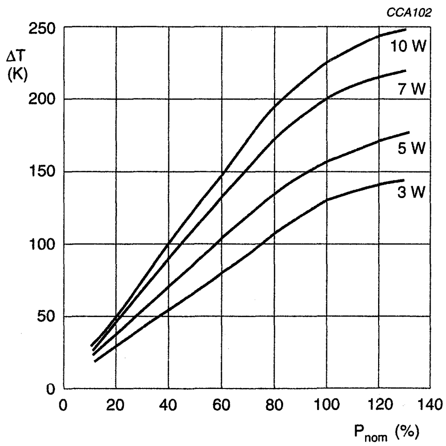
Termination length: 10 mm.

Fig.4 Solder spot temperature rise (ΔT) as a function of dissipated power.



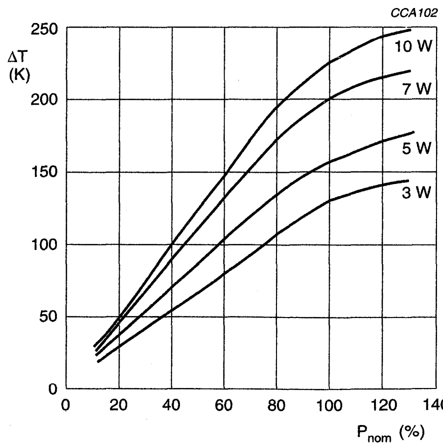
Termination length: 25 mm.

Fig.5 Solder spot temperature rise (ΔT) as a function of dissipated power.



Termination length: 10 mm.

Fig.6 Hot-spot temperature rise (ΔT) as a function of dissipated power.



Termination length: 25 mm.

Fig.7 Hot-spot temperature rise (ΔT) as a function of dissipated power.

Radial mounted power resistors

RMW03/05/07/10 RMF03/05/07/10

MECHANICAL DATA

Marking

The resistor is marked with the resistor type designation, the production week, nominal resistance value, the tolerance on the resistance and the rated dissipation at T_{amb} = 70 °C.

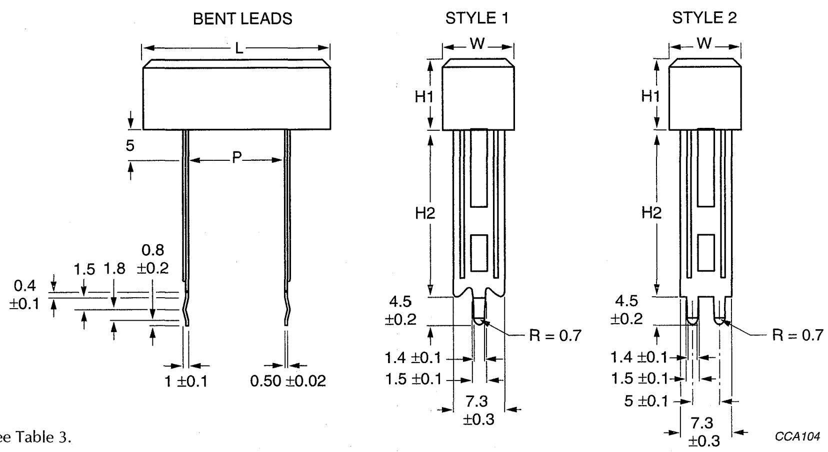
For values up to 910 Ω the R is used as a decimal point. For values of 1 kΩ or greater the letter K is used as the decimal point for the kΩ indication.

Mass per 100 units

TYPE	MASS (g)		
	10 mm LEAD	25 mm LEAD	30 mm LEAD
RMW03	700	750	–
RMF03	800	850	–
RMW05	700	750	–
RMF05	800	850	–

TYPE	MASS (g)		
	10 mm LEAD	25 mm LEAD	30 mm LEAD
RMW07	800	900	–
RMF07	900	1000	–
RMW10	1100	1150	–
RMF10	1200	1250	–

Outlines



For dimensions see Table 3.

Fig.8 Outlines.

Table 3 Resistor type and relevant physical dimensions; see Fig.8

TYPE	W (mm)	L (mm)	H1 (mm)	H2 (mm)	P (mm)
RMW03 RMF03	9.0 ±1	24 ±1	9.0 ±1	10 ±1.5 or 25 ±1.5	12.5 ±1
RMW05 RMF05	9.5 ±1	27 ±1	9.5 ±1		15.0 ±1
RMW07 RMF07	9.5 ±1	35 ±1	9.5 ±1		22.5 ±1
RMW10 RMF10	9.5 ±1	48 ±1	9.5 ±1		35.0 ±1

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of *"IEC publications 60115-1 and 60115-4"*, category 25/155/56 (rated temperature range −25 °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 Table 4 the tests and requirements are listed with reference to the relevant clauses of *"IEC publications 60115-1, 60115-4 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.

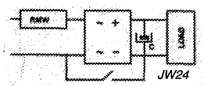
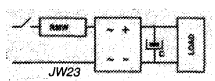
All soldering tests are performed with mildly activated flux.

Table 4 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				
4.15		robustness of resistor body	load 200 ±10 N	no visible damage ΔR/R max.: ±1% + 0.05 Ω
4.16	21 (U)	robustness of terminations:		
	21 (Ua1)	tensile all samples	load 45 N; 10 s	no visible damage
4.17	20 (Ta)	solderability	2 s; 235 °C; flux 600	good tinning; no damage ΔR/R max.: ±0.5% + 0.05 Ω
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C	ΔR/R max.: ±1% + 0.05 Ω
4.19	14 (Na)	rapid change of temperature	30 minutes at −25 °C and 30 minutes at +155 °C; 5 cycles	no visible damage ΔR/R max.: ±1% + 0.05 Ω
4.22	6 (Fc)	vibration	frequency 10 to 55 Hz; displacement 0.75 mm or acceleration 10 g; 3 directions; total 6 hours (3 × 2 hours)	no visible damage ΔR/R max.: ±1% + 0.05 Ω
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	16 hours; 155 °C	
4.23.3	30 (Db)	damp heat (accelerated) 1st cycle	24 hours; 55 °C; 95 to 100% RH	
4.23.4	1 (Aa)	cold	2 hours; −25 °C	
4.23.5	13 (M)	low air pressure	1 hour; 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	after 24 hours at P_n ΔR/R max.: ±1% + 0.05 Ω

Radial mounted power resistors

RMW03/05/07/10
RMF03/05/07/10

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	no visible damage ΔR/R max.: ±3% + 0.1 Ω
4.8.4.2		temperature coefficient	at 20/–25/20 °C, 20/155/20 °C: R ≤ 1 Ω R > 1 Ω	 TC ≤ ±600 × 10^{-6}/K TC ≤ +200 × 10^{-6}/K
4.13		short time overload	room temperature; dissipation 10 × P_n; 5 s **RMF03**: V ≤ 1 500 V **RMF05**: V ≤ 2 000 V **RMF07**: V ≤ 2 500 V **RMF10**: V ≤ 3 000 V	ΔR/R max.: ±2% + 0.1 Ω
4.25.1		endurance (at 70 °C)	1 000 hours loaded with P_n; 1.5 hours on and 0.5 hours off	no visible damage R/R max.: ±5% + 0.1 Ω
4.25.3		endurance at upper category temperature	1 000 hours; 155 °C; no load	no visible damage ΔR/R max.: ±5% + 0.1 Ω
4.6.1.1		insulation resistance	500 V (DC); 1 minute	≥100 MΩ
4.7		voltage proof on insulation	1000 V (RMS); 1 minute	ΔR/R max.: ±0.5% + 0.05 Ω
Additional tests in accordance with BPV53-8.753/044				
1; note 1		interruption after dump	simplified test circuit (safety box required): V_1 = 256 V_{AC} C = 100 μF load = 1 640 Ω  procedure: switch on the circuit; after warming up time minimum 5s; short circuit one of the diodes in the bridge rectifier	the resistor must interrupt without any sign of flame or material ejected from its body
2; note 1		inrush current test	simplified test circuit (safety box required): V_1 = 256 V_{AC} C = 500 μF load = 1 640 Ω  procedure: pulse on/off the circuit for 10 times; interval between pulses: 10 s maximum	ΔR/R max.: ±2% + 0.1 Ω

Note

1. Value range for RMW05 and RMW07: 1 Ω < value range ≤ 10 Ω.

Cemented wirewound precision resistors

PAC01/02/03/04/05/06

FEATURES

- High power dissipation in small volume
- High pulse load handling capabilities.
- TC100.

APPLICATIONS

- Where power, pulse loading capability and precision needs to be combined.

DESCRIPTION

The resistor element is a resistive wire which is wound in a single layer on a ceramic rod. Metal caps are pressed over the ends of the rod. The ends of the resistance wire and the leads are connected to the caps by welding. Tinned copper-clad iron leads with poor heat conductivity are employed permitting the use of relatively short leads to obtain stable mounting without overheating the solder joint.

The resistor is coated with a green silicon cement which is not resistant to aggressive fluxes. The coating is non-inflammable, will not drip even at high overloads and is resistant to most commonly used cleaning solvents, in accordance with *"MIL-STD-202E, method 215"* and *"IEC 60068-2-45"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE					
	PAC01	PAC02	PAC03	PAC04	PAC05	PAC06
Resistance range	0.22 Ω to 2.2 kΩ	0.10 Ω to 3.6 kΩ	0.10 Ω to 4.7 kΩ	0.10 Ω to 8.2 kΩ	0.68 Ω to 10 kΩ	0.68 Ω to 12 kΩ
Resistance tolerance	±1%; E24/E96 series					
Maximum permissible body temperature	275 °C					
Rated dissipation at T_{amb} = 25 °C	1 W	2 W	3 W	4 W	5 W	6 W
Temperature coefficient; note 1	≤±100 × 10^{-6}/K					
Climatic category	55/200/56					
Specification based on	IEC 60115-1; MIL-R-26					
Stability after:						
load, 1 000 hours	ΔR/R max.: ±0.5% + 0.05 Ω					
climatic tests	ΔR/R max.: ±0.5% + 0.05 Ω					
short time overload	ΔR/R max.: ±0.2% + 0.05 Ω					

Note

1. TC30, 50 or 90 is available on request for specific ranges

ORDERING INFORMATION

Table 1 Ordering code indicating type and packaging

TYPE	ORDERING CODE 2306 327	
	BANDOLIER IN AMMOPACK[1]	
	500 units	1 000 units
PAC01	–	5....
PAC02	0....	–
PAC03	1....	–
PAC04	2....	–
PAC05	3....	–
PAC06	4....	–

Note

1. Radial taped version available on request.

Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2306 327
- The subsequent first digit indicates the resistor type and packaging; see Table 1.
- 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 Table 2.

Table 2 Last digit of 12NC

RESISTANCE DECADE	LAST DIGIT
0.10 to 0.976 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 12 kΩ	3

ORDERING EXAMPLE

The ordering code of an PAC02 resistor, value 47 Ω, supplied in ammopack of 500 units is: 2306 327 04709.

Product specifications deviating from the standard values are available on request.

FUNCTIONAL DESCRIPTION

Product characterization

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

Limiting values

TYPE	LIMITING VOLTAGE[(1)] (V)	LIMITING POWER (W)
PAC01	$V = \sqrt{P_n \times R}$	1
PAC02		2
PAC03		3
PAC04		4
PAC05		5
PAC06		6

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 275 °C.

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.1.

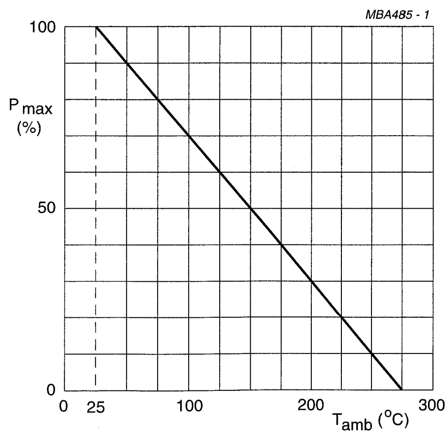


Fig.1 Maximum dissipation (P_{max}) as a function of the ambient temperature (T_{amb}).

PULSE LOADING CAPABILITY

Detailed pulse loading information is available on request.

Application information

MOUNTING

The resistor is suitable for processing on cutting and bending machines.

Ensure that the temperature rise of the resistor body by conducted or convected heat, does not affect nearby components or materials.

MECHANICAL DATA

Mass per 100 units

TYPE	MASS (g)
PAC01	55
PAC02	80
PAC03	100
PAC04	175
PAC05	215
PAC06	225

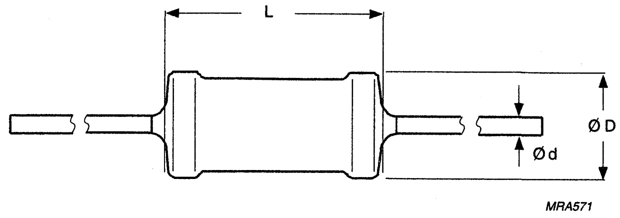
Marking

The resistor is marked with the nominal resistance value, the tolerance on the resistance and the rated dissipation at T_{amb} = 25 °C.

For values up to 910 Ω, the R is used as the decimal point.

For values of 1 kΩ and upwards, the letter K is used as the decimal point for the kΩ indication.

Outline



For dimensions see Table 3.

Fig.2 Component outline.

Table 3 Resistor type and relevant physical dimensions; see Fig.2

TYPE	ØD MAX. (mm)	L MAX. (mm)	Ød (mm)
PAC01	4.3	10	0.8 ±0.03
PAC02	5.5	13	
PAC03	5.5	17	
PAC04	7.5	17	
PAC05	7.5	23	
PAC06	7.5	25	

Cemented wirewound precision resistors

PAC01/02/03/04/05/06

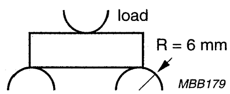
TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of *"IEC publications 60115-1 and 60115-4"*, category 55/200/56 (rated temperature range −55 °C to +200 °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, *"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 Table 4 the tests and requirements are listed with reference to the relevant clauses of *"IEC publications 60115-1, 60115-4 and 68"*; 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.

Table 4 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
Tests in accordance with the schedule of IEC publication 60115-1				
4.15		robustness of resistor body	load 200 ±10 N 	no visible damage ΔR/R max.: ±0.1% + 0.05 Ω
4.16	U	robustness of terminations:		
	Ua	tensile all samples	load 10 N; 10 s	
	Ub	bending half number of samples	load 5 N 90°, 180°, 90°	
	Uc	torsion other half of samples	2 × 180° in opposite directions	no visible damage ΔR/R max.: ±0.1% + 0.05 Ω
4.17	Ta	solderability	2 s; 235 °C; flux 600	good tinning; no damage
4.18	Tb	resistance to soldering heat	thermal shock: 3 s; 350 °C; 2.5 mm from body	ΔR/R max.: ±0.2% + 0.05 Ω
4.19	14 (Na)	rapid change of temperature	30 minutes at −55 °C and 30 minutes at +200 °C; 5 cycles	no visible damage ΔR/R max.: ±0.5% + 0.05 Ω
4.22	Fc	vibration	frequency 10 to 500 Hz; displacement 0.75 mm or acceleration 10 g; 3 directions; total 6 hours (3 × 2 hours)	no damage ΔR/R max.: ±0.1% + 0.05 Ω
4.20	Eb	bump	4000 ±10 bumps; 390 m/s^2	no damage ΔR/R max.: ±0.1% + 0.05 Ω

IEC 60115-1 CLAUSE	IEC 60068 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.23		climatic sequence:		
4.23.2	Ba	dry heat	16 hours; 200 °C	
4.23.3	Db	damp heat (accelerated) 1st cycle	24 hours; 55 °C; 95 to 100% RH	
4.23.4	Aa	cold	2 hours; −55 °C	
4.23.5	M	low air pressure	1 hour; 8.5 kPa; 15 to 35 °C	
4.23.6	Db	damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 to 100% RH	ΔR/R max.: ±0.5% + 0.05 Ω
4.24.2	3 (Ca)	damp heat (steady state)	56 days; 40 °C; 90 to 95% RH; dissipation ≤0.01 P_n	no visible damage ΔR/R max.: ±1% + 0.05 Ω
4.8.4.2		temperature coefficient	at 20/−55/20 °C, 20/200/20 °C (TC × 10^{-6}/K)	TC ≤ ±100 × 10^{-6}/K
4.13		short time overload	room temperature; dissipation 10 × P_n; 5 s	ΔR/R max.: ±0.2% + 0.05 Ω
4.25.1		endurance (at 25 °C)	1 000 hours loaded with P_n; 1.5 hours on and 0.5 hours off	no visible damage ΔR/R max.: ±0.5% + 0.05 Ω
4.23.2	27 (Ba)	endurance at upper category temperature	1000 hours; 200 °C; no load	no visible damage ΔR/R max.: ±1% + 0.05 Ω

Low ohmic resistor LVR05

FEATURES

- Designed to dissipate high powers in a small volume.

APPLICATIONS

- Where extremely low ohmic values and high stability are essential.
- Low temperature coefficient and low inductance.

DESCRIPTION

The resistor element is a special resistive material which is shaped to assure maximum power distribution and ohmic stability.

Tinned copper-clad iron leads are welded to the resistive element and the assembly is housed within a rectangular case which is non-flammable.

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

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Resistance range; note 1	0.01 to 0.10 Ω
Resistance tolerance and series; note 2	±5%: E24 series
Rated dissipation at T_{amb} = 40 °C	5 W
Temperature coefficient; note 3	$\pm200 \times 10^{-6}$/K
Maximum permissible body temperature	275 °C
Operating temperature	−25 °C to +155 °C
Insulation voltage	>2000 V
Basic specifications	*IEC 60115-1B*
Climatic category (IEC 60068)	25/155/56
Stability after:	
load (1000 hours)	ΔR/R max.: ±5% + 0.1 Ω
climatic test	ΔR/R max.: ±3% + 0.1 Ω
soldering	ΔR/R max.: ±2% + 0.1 Ω
Noise	max. 2.5 µV/V

Notes

1. Lower values are available on request.
2. 1%, 2% and 3% tolerance available on request.
3. Special TC available on request.

ORDERING INFORMATION

Table 1 Ordering code indicating resistance value, tolerance, style and packaging

TYPE	RESISTANCE VALUE (Ω)	TOLERANCE (%)	CODE NUMBER 2306 288 5.... 250 UNITS IN CARDBOARD BOX AXIAL[1]
LVR05	0.01	±5	0001
	0.011		0002
	0.012		0003
	0.013		0004
	0.015		0005
	0.016		0006
	0.018		0007
	0.020		0008
	0.022		0009
	0.024		0011
	0.027		0012
	0.030		0013
	0.033		0014
	0.036		0015
	0.039		0016
	0.043		0017
	0.047		0018
	0.051		0019
	0.056		0021
	0.062		0022
	0.068		0023
	0.075		0024
	0.082		0025
	0.091		0026

Note

1. A radial type is available on request, code number 2306 288 9....

Ordering example

The ordering code for a LVR05, axial leaded resistor value 0.01 Ω, 5% tolerance, supplied in cardboard box of 250 units, is: 2306 288 50001.

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of rated resistance (nominal resistance) are taken from the E24 series with a tolerance of 5%. The values of the E24 series are in accordance with *"IEC publication 60063"*.

The maximum permissible hot-spot temperature is 275 °C.

Limiting values

TYPE	LIMITING VOLTAGE(1) (V)	LIMITING POWER (W)
LVR05	$V = \sqrt{P_n \times R}$	5

Note

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

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.1.

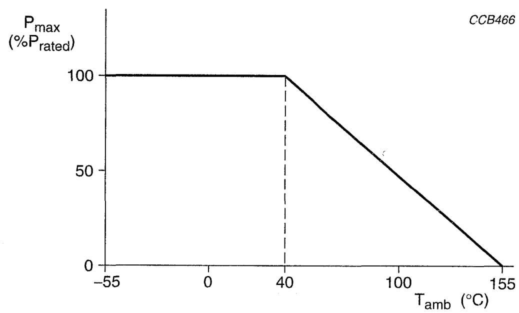


Fig.1 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

Application information

For temperature rise at soldering point see Fig.2.

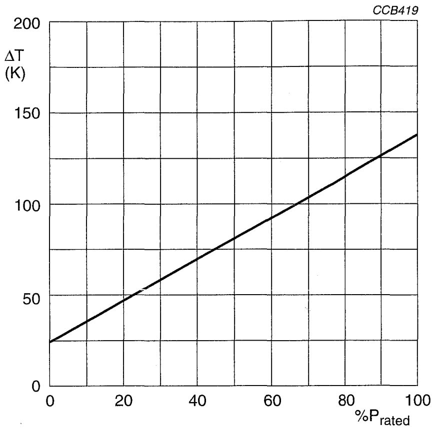


Fig.2 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power measured at points C; see Fig.4.

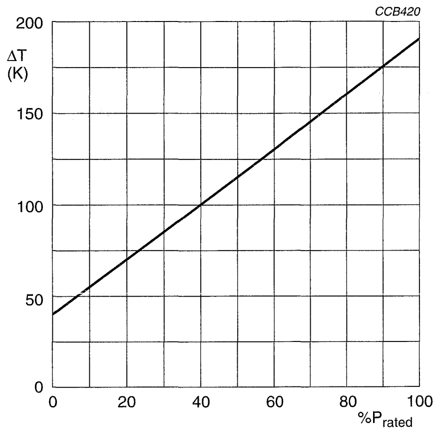


Fig.3 Temperature rise of the resistor body (ΔT) as a function of dissipated power.

MECHANICAL DATA

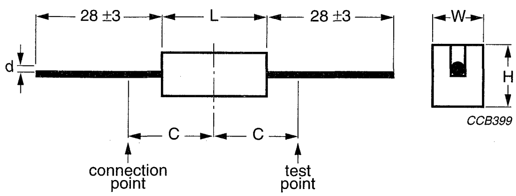
Marking

The nominal resistance, tolerance on the resistance, rated dissipation at 40 °C and the production date are printed on the resistor body. The 'R' is used as a decimal point.

Mass per 100 units

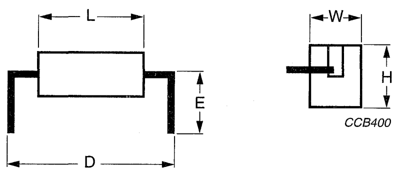
TYPE	MASS (g)
LVR05	350

Outlines



Dimensions in mm.
For dimensions see Table 2.

Fig.4 Outline; axial leads.



For dimensions see Table 2.

Fig.5 Outline; radial leads.

Table 2 Resistor type and relevant physical dimensions; see Figs 4 and 5

TYPE	L (mm)	W and H (mm)	Ød (mm)	C (mm)	D (mm)	E (mm)
LVR05	22 ±1.5	8 ±1.0	1.0 ±0.05	8 ±1.0	27.95 ±0.4	3.5 ±0.5

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: **L**ower **C**ategory **T**emperature, **U**pper **C**ategory **T**emperature; damp heat, long term, **56** days).

The tests are carried out in accordance with IEC publication 60068, *"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 Table 3 the tests and requirements are listed with reference to the relevant clauses of *"IEC publications 60115-1 and 60068"*; 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.

Table 3 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.15		robustness of resistor body	load 100 ±10 N	no damage ΔR/R max.: 1.0%
4.16	U	robustness of terminations:		
4.16.2	Ua	tensile all samples	load 10 N; 10 s	
4.16.3	Ub	bending half number of samples	load 5 N; 4 × 90°	
4.16.4	Uc	torsion other half of samples	2 × 180° in opposite directions	no damage ΔR/R max.: 0.5%
4.17	Ta	solderability	2 s; 230 °C; flux 600	good tinning; no damage
4.18	Tb	resistance to soldering heat	thermal shock: 3 s; 350 °C; 6 mm from body	ΔR/R max.: 1%
4.19	Na	rapid change of temperature	30 minutes at −25 °C and 30 minutes at +155 °C; 5 cycles	no visible damage ΔR/R max.: 1%
4.22	Fc	vibration	frequency 10 to 55 Hz; displacement 0.75 mm or acceleration 10 g; 3 directions; total 6 hours (3 × 2 hours)	no damage ΔR/R max.: 1%
4.23		climatic sequence:		
4.23.2	Ba	dry heat	16 hours; 155 °C	
4.23.3	Db	damp heat (accelerated) 1st cycle	24 hours; 55 °C; 90 to 100% RH	
4.23.4	Aa	cold	2 hours; −25 °C	
4.23.5	M	low air pressure	2 hours; 8.5 kPa; 15 to 35 °C	
4.23.6	Db	damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 to 100% RH; after 24 hours at P_n	ΔR/R max.: 3%
4.24.2	Ca	damp heat (steady state)	21 days; 40 °C; 90 to 95% RH; dissipation 0.01 P_n	ΔR/R max.: 3%

Low ohmic resistor LVR05

IEC 60115-1 CLAUSE	IEC 60068 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.25.1		endurance (at 40 °C)	1000 hours loaded with P_n; 1.5 hours on 0.5 hours off	ΔR/R max.: 5%
4.23.2	Ba	endurance at upper category temperature	1000 hours at 155 °C, no load	no visible damage ΔR/R max.: 5%
4.8.4		temperature coefficient	between −25 °C and +155 °C (TC × 10^{-6}/K)	±200 × 10^{-6}/K
4.6.1.1		insulation resistance	500 V (DC) during 1 minute; V-block method	R_{ins} min.: 10^2 MΩ
4.13		short time overload	room temperature; dissipation 10 × P_n; 5 s	ΔR/R max.: 2%

MAINTENANCE TYPE

Professional leaded resistors MRS16; MRS25

FEATURES

- Professional resistors in small outlines
- Low noise.

APPLICATIONS

- All general purpose applications.

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 the MBA 0204 and MBB 0207 professional.

QUICK REFERENCE DATA

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, $\Delta R/R$ max., after:		
load:		
R ≤ 100 kΩ	±(0,5% + 0,05 Ω)	±(0,5% + 0,05 Ω)
R > 100 kΩ	±(1% + 0,05 Ω)	±(0,5% + 0,05 Ω)
climatic tests:		
R ≤ 100 kΩ	±(0,5% + 0,05 Ω)	±(0,5% + 0,05 Ω)
R > 100 kΩ	±(1% + 0,05 Ω)	±(0,5% + 0,05 Ω)
soldering:		
R ≤ 100 kΩ	±(0,1% + 0,05 Ω)	±(0,1% + 0,05 Ω)
R > 100 kΩ	±(0,25% + 0,05 Ω)	±(0,1% + 0,05 Ω)
short time overload	±(0,25% + 0,05 Ω)	±(0,25% + 0,05 Ω)

Professional leaded resistors MRS16; MRS25

ORDERING INFORMATION

Numeric Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2322 15.
- The subsequent 2 digits indicate the resistor type and packaging; see Table 1.
- 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 Table 2.

Table 1 Ordering code indicating resistor type and packaging

TYPE	ORDERING CODE 2322 15.		
	BANDOLIER IN AMMOPACK		BANDOLIER ON REEL
	1000 units	**5000 units**	**5000 units**
MRS16	7 1....	7 2....	7 3....
MRS25	6 1....	6 2....	6 3....

Table 2 Last digit of 12NC indicating resistance decade

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

ORDERING EXAMPLE

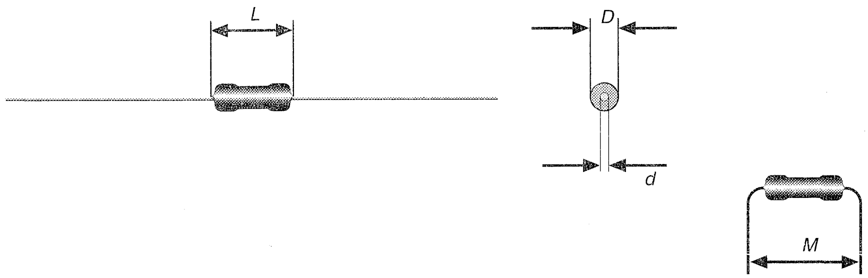
The ordering code of a MRS16 resistor, value 750 Ω, on a bandolier of 1000 units in ammopack is: 2322 157 17501.

Professional leaded resistors

MRS16; MRS25

MECHANICAL DATA

Outlines



For dimensions see Table 3.

Fig.2 Outline.

Table 3 Leaded resistor types, mass and relevant physical dimensions; see Fig.2

TYPE	VERSION	D_{max} (mm)	L_{max} (mm)	d_{nom} (mm)	M_{min} (mm)	MASS (mg)
MRS 16	A	1.6	3.6	0.5	5.0	125
	B	1.9	3.4	0.5	5.0	125
MRS 25	–	2.5	6.5	0.6	10.0	700

Note

1. Due to the various sources of production, delivery of specific versions (A or B) of MRS 16 cannot be guaranteed.

NAFTA CROSS REFERENCE

NAFTA ORDERING CODES

Table 1 Ordering code indicating resistor type and packaging

TYPE	TOL. (%)	RESISTANCE RANGE	12NC	NAFTA PART NUMBER[1]	TAPING (mm)	SPQ (units)
MMU0102 PROFEFSSIONAL						
MMU0102	–	jumper	2312 165 90001	9B08053A0R00JC00T	–	3000; tape & reel
			2312 175 90001	9B08053A0R00JC003	–	10000; tape & reel
MMU0102-50	±5	0.22 to 0.91 Ω	2312 165 3....	9B08053AxxxxJC00T	–	3000; tape & reel
			2312 175 3....	9B08053AxxxxJC003	–	10000; tape & reel
	±2	1.0 to 9.1 Ω	2312 165 2....	9B08053AxxxxGC00T	–	3000; tape & reel
			2312 175 2....	9B08053AxxxxGC003	–	10000; tape & reel
	±1	10.0 Ω to 2.21 MΩ	2312 165 1....	9B08053AxxxxFC00T	–	3000; tape & reel
			2312 175 1....	9B08053AxxxxFC003	–	10000; tape & reel
	±0.50	47.0 Ω to 221 kΩ	2312 165 5....	9B08053AxxxxDC00T	–	3000; tape & reel
			2312 175 5....	9B08053AxxxxDC003	–	10000; tape & reel
MMU0102-25	±1	10.0 Ω to 221 kΩ	2312 166 1....	9B08053AxxxxFE00T	–	3000; tape & reel
			2312 176 1....	9B08053AxxxxFE003	–	10000; tape & reel
	±0.50	47.0 Ω to 221 kΩ	2312 166 5....	9B08053AxxxxDE00T	–	3000; tape & reel
			2312 176 5....	9B08053AxxxxDE003	–	10000; tape & reel
MMA0204 PROFESSIONAL						
MMA0204	–	jumper	2312 155 90001	9B14064A0R00JC00A	–	3000; tape & reel
			2312 145 90001	9B14064A0R00JC003	–	10000; tape & reel
MMA0204-50	±5	0.22 to 0.91 Ω	2312 155 3....	9B14064AxxxxJC00A	–	3000; tape & reel
			2312 145 3....	9B14064AxxxxJC003	–	10000; tape & reel
	±1	1.0 Ω to 10 MΩ	2312 155 1....	9B14064AxxxxFC00A	–	3000; tape & reel
			2312 145 1....	9B14064AxxxxFC003	–	10000; tape & reel
	±0.50	10.0 Ω to 475 kΩ	2312 155 5....	9B14064AxxxxDC00A	–	3000; tape & reel
			2312 145 5....	9B14064AxxxxDC003	–	10000; tape & reel
MMA0204-25	±1	10.0 Ω to 475 kΩ	2312 156 1....	9B14064AxxxxFE00A	–	3000; tape & reel
			2312 146 1....	9B14064AxxxxFE003	–	10000; tape & reel
	±0.50	10.0 Ω to 475 kΩ	2312 156 5....	9B14064AxxxxDE00A	–	3000; tape & reel
			2312 146 5....	9B14064AxxxxDE003	–	10000; tape & reel
MMB0207 PROFESSIONAL						
MMB0207	–	jumper	2312 195 90001	9B02077A0R00JD002	–	2000; tape & reel
			2312 185 90001	9B02077A0R00JD007	–	7000; tape & reel
MMB0207-00	±5	0.1 to 0.2 Ω	2312 195 3....	9B02077AxxxxJD002	–	2000; tape & reel
			2312 185 3....	9B02077AxxxxJD007	–	7000; tape & reel
	±5	0.22 to 0.91 Ω	2312 195 3....	9B02077AxxxxJC002	–	2000; tape & reel
			2312 185 3....	9B02077AxxxxJC007	–	7000; tape & reel
MMB0207-50	±2	0.22 to 0.91 Ω	2312 195 2....	9B02077AxxxxGC002	–	2000; tape & reel
			2312 185 2....	9B02077AxxxxGC007	–	7000; tape & reel

NAFTA ordering information

Cross reference

TYPE	TOL. (%)	RESISTANCE RANGE	12NC	NAFTA PART NUMBER[1]	TAPING (mm)	SPQ (units)
MMB0207-50	±1	1.0 Ω to 8.2 MΩ	2312 195 1....	9B02077AxxxxFC002	–	2000; tape & reel
			2312 185 1....	9B02077AxxxxFC007	–	7000; tape & reel
MMB0207-25	±0.50	10.0 Ω to 1 MΩ	2312 196 5....	9B02077AxxxxDE002	–	2000; tape & reel
			2312 186 5....	9B02077AxxxxDE007	–	7000; tape & reel
MMU0102 PRECISION						
MMU0102-25	±0.25	100.0 Ω to 221 kΩ	2312 171 6....	9B08053AxxxxCE001	–	1000; tape & reel
			2312 166 6....	9B08053AxxxxCE00T	–	3000; tape & reel
			2312 176 6....	9B08053AxxxxCE003	–	10000; tape & reel
	±0.10	100.0 Ω to 100 kΩ	2312 171 7....	9B08053AxxxxBE001	–	1000; tape & reel
			2312 166 7....	9B08053AxxxxBE00T	–	3000; tape & reel
			2312 176 7....	9B08053AxxxxBE003	–	10000; tape & reel
MMU0102-15	±0.50	100.0 Ω to 100 kΩ	2312 172 5....	9B08053AxxxxDF001	–	1000; tape & reel
			2312 167 5....	9B08053AxxxxDF00T	–	3000; tape & reel
			2312 177 5....	9B08053AxxxxDF003	–	10000; tape & reel
	±0.25	100.0 Ω to 100 kΩ	2312 172 6....	9B08053AxxxxCF001	–	1000; tape & reel
			2312 167 6....	9B08053AxxxxCF00T	–	3000; tape & reel
			2312 177 6....	9B08053AxxxxCF003	–	10000; tape & reel
	±0.10	100.0 Ω to 100 kΩ	2312 172 7....	9B08053AxxxxBF001	–	1000; tape & reel
			2312 167 7....	9B08053AxxxxBF00T	–	3000; tape & reel
			2312 177 7....	9B08053AxxxxBF003	–	10000; tape & reel
MMA0204 PRECISION						
MMA0204-25	±0.25	22.0 Ω to 332 kΩ	2312 141 6....	9B14064AxxxxCE001	–	1000; tape & reel
			2312 156 6....	9B14064AxxxxCE00A	–	3000; tape & reel
			2312 146 6....	9B14064AxxxxCE003	–	10000; tape & reel
	±0.10	43.0 Ω to 332 kΩ	2312 141 7....	9B14064AxxxxBE001	–	1000; tape & reel
			2312 156 7....	9B14064AxxxxBE00A	–	3000; tape & reel
			2312 146 7....	9B14064AxxxxBE003	–	10000; tape & reel
MMA0204-15	±0.50	10.0 Ω to 221 kΩ	2312 142 5....	9B14064AxxxxDF001	–	1000; tape & reel
			2312 157 5....	9B14064AxxxxDF00A	–	3000; tape & reel
			2312 147 5....	9B14064AxxxxDF003	–	10000; tape & reel
	±0.25	22.0 Ω to 221 kΩ	2312 142 6....	9B14064AxxxxCF001	–	1000; tape & reel
			2312 157 6....	9B14064AxxxxCF00A	–	3000; tape & reel
			2312 147 6....	9B14064AxxxxCF003	–	10000; tape & reel
	±0.10	43.0 Ω to 221 kΩ	2312 142 7....	9B14064AxxxxBF001	–	1000; tape & reel
			2312 157 7....	9B14064AxxxxBF00A	–	3000; tape & reel
			2312 147 7....	9B14064AxxxxBF003	–	10000; tape & reel

NAFTA ordering information

Cross reference

TYPE	TOL. (%)	RESISTANCE RANGE	12NC	NAFTA PART NUMBER[1]	TAPING (mm)	SPQ (units)
MMB0207 PRECISION						
MMB0207-25	±0.25	15.0 Ω to 1 MΩ	2312 181 6....	9B02077AxxxxCE001	–	1000; tape & reel
			2312 196 6....	9B02077AxxxxCE002	–	2000; tape & reel
			2312 186 6....	9B02077AxxxxCE007	–	7000; tape & reel
	±0.10	33.0 Ω to 1 MΩ	2312 181 7....	9B02077AxxxxBE001	–	1000; tape & reel
			2312 196 7....	9B02077AxxxxBE002	–	2000; tape & reel
			2312 186 7....	9B02077AxxxxBE007	–	7000; tape & reel
MMB0207-15	±0.10	33.0 Ω to 1 MΩ	2312 182 7....	9B02077AxxxxBF001	–	1000; tape & reel
			2312 197 7....	9B02077AxxxxBF002	–	2000; tape & reel
			2312 187 7....	9B02077AxxxxBF007	–	7000; tape & reel
MBA0204 PROFESSIONAL						
MBA0204	–	jumper	2312 900 90001	A0204C0R000J1A	52	1000; ammopack
			2312 905 90001	A0204C0R000J5A	52	5000; ammopack
MBA0204-50	±5	0.22 to 0.91 Ω	2312 900 3....	A0204CxxxxxJ1A	52	1000; ammopack
			2312 905 3....	A0204CxxxxxJ5A	52	5000; ammopack
	±1	1.0 Ω to 10 MΩ	2312 900 1....	A0204CxxxxxF1A	52	1000; ammopack
			2312 905 1....	A0204CxxxxxF5A	52	5000; ammopack
	±0.50	10.0 Ω to 475 kΩ	2312 900 5....	A0204CxxxxxD1A	52	1000; ammopack
			2312 905 5....	A0204CxxxxxD5A	52	5000; ammopack
MBA0204-25	±1	10.0 Ω to 475 kΩ	2312 901 1....	A0204ExxxxxF1A	52	1000; ammopack
			2312 906 1....	A0204ExxxxxF5A	52	5000; ammopack
	±0.50	10.0 Ω to 475 kΩ	2312 901 5....	A0204ExxxxxD1A	52	1000; ammopack
			2312 906 5....	A0204ExxxxxD5A	52	5000; ammopack
MBB0207 PROFESSIONAL						
MBB0207	–	jumper	2312 910 90001	B0207C0R000J1A	52	1000; ammopack
			2312 915 90001	B0207C0R000J5A	52	5000; ammopack
MBB0207-50	±5	0.22 to 0.91 Ω	2312 910 3....	B0207CxxxxxJ1A	52	1000; ammopack
		11 to 22 MΩ				
		0.22 to 0.91 Ω	2312 915 3....	B0207CxxxxxJ5A	52	5000; ammopack
		11 to 22 MΩ				
	±1	1.0 Ω to 10 MΩ	2312 910 1....	B0207CxxxxxF1A	52	1000; ammopack
			2312 915 1....	B0207CxxxxxF5A	52	5000; ammopack
	±0.50	10.0 Ω to 475 kΩ	2312 910 5....	B0207CxxxxxD1A	52	1000; ammopack
			2312 915 5....	B0207CxxxxxD5A	52	5000; ammopack
MBB0207-25	±1	10.0 Ω to 475 kΩ	2312 911 1....	B0207ExxxxxF1A	52	1000; ammopack
			2312 916 1....	B0207ExxxxxF5A	52	5000; ammopack
	±0.50	10.0 Ω to 475 kΩ	2312 911 5....	B0207ExxxxxD1A	52	1000; ammopack
			2312 916 5....	B0207ExxxxxD5A	52	5000; ammopack

NAFTA ordering information

Cross reference

TYPE	TOL. (%)	RESISTANCE RANGE	12NC	NAFTA PART NUMBER(1)	TAPING (mm)	SPQ (units)
MBE0414 PROFESSIONAL						
MBE0414-50	±5	0.22 to 0.91 Ω	2312 920 3....	E0414CxxxxxJ1A	63	1000; ammopack
	±1	1.0 Ω to 22 MΩ	2312 920 1....	E0414CxxxxxF1A	63	1000; ammopack
	±0.50	10.0 Ω to 2.4 MΩ	2312 920 5....	E0414CxxxxxD1A	63	1000; ammopack
MBE0414-25	±1	10.0 Ω to 2.4 MΩ	2312 921 1....	E0414ExxxxxF1A	63	1000; ammopack
	±0.50	10.0 Ω to 2.4 MΩ	2312 921 5....	E0414ExxxxxD1A	63	1000; ammopack
MBA0204 PRECISION						
MBA0204-25	±0.25	22.0 Ω to 332 kΩ	2312 901 6....	A0204ExxxxxC1A	52	1000; ammopack
			2312 906 6....	A0204ExxxxxC5A	52	5000; ammopack
	±0.10	43.0 Ω to 332 kΩ	2312 901 7....	A0204ExxxxxB1A	52	1000; ammopack
			2312 906 7....	A0204ExxxxxB5A	52	5000; ammopack
MBA0204-15	±0.25	22.0 Ω to 221 kΩ	2312 902 6....	A0204FxxxxxC1A	52	1000; ammopack
			2312 907 6....	A0204FxxxxxC5A	52	5000; ammopack
	±0.10	43.0 Ω to 221 kΩ	2312 902 7....	A0204FxxxxxB1A	52	1000; ammopack
			2312 907 7....	A0204FxxxxxB5A	52	5000; ammopack
MBB0207 PRECISION						
MBB0207-25	±0.25	10.0 Ω to 1 MΩ	2312 911 6....	B0207ExxxxxC1A	52	1000; ammopack
			2312 916 6....	B0207ExxxxxC5A	52	5000; ammopack
	±0.10	40.2 Ω to 1 MΩ	2312 911 7....	B0207ExxxxxB1A	52	1000; ammopack
			2312 916 7....	B0207ExxxxxB5A	52	5000; ammopack
MBB0207-15	±0.25	10.0 Ω to 562 kΩ	2312 912 6....	B0207FxxxxxC1A	52	1000; ammopack
			2312 917 6....	B0207FxxxxxC5A	52	5000; ammopack
	±0.10	40.2 Ω to 562 kΩ	2312 912 7....	B0207FxxxxxB1A	52	1000; ammopack
			2312 917 7....	B0207FxxxxxB5A	52	5000; ammopack
MBE0414 PRECISION						
MBE0414-25	±0.25	22.2 Ω to 1.5 MΩ	2312 921 6....	E0414ExxxxxC1A	63	1000; ammopack
	±0.10	43.0 Ω to 1 MΩ	2312 921 7....	E0414ExxxxxB1A	63	1000; ammopack
MBE0414-15	±0.25	22.0 Ω to 1 MΩ	2312 922 6....	E0414FxxxxxC1A	63	1000; ammopack
	±0.10	43.0 Ω to 1 MΩ	2312 922 7....	E0414FxxxxxB1A	63	1000; ammopack
UXA0204 ULTRA PRECISION						
UXA0204-10	±0.25	22.0 Ω to 221 kΩ	2312 662 2....	UXABxxxxxxC1A	–	1000; ammopack
	±0.10	43.0 Ω to 221 kΩ	2312 662 3....	UXABxxxxxxB1A	–	1000; ammopack
	±0.05	100.0 Ω to 180 kΩ	2312 662 4....	UXABxxxxxxA1A	–	1000; ammopack
	±0.01	200.0 Ω to 150 kΩ	2312 662 7....	UXABxxxxxxT1A	–	1000; ammopack
UXA0204-05	±0.25	47.0 Ω to 150 kΩ	2312 663 2....	UXAAxxxxxxC1A	–	1000; ammopack
	±0.10	47.0 Ω to 150 kΩ	2312 663 3....	UXAAxxxxxxB1A	–	1000; ammopack
	±0.05	100.0 Ω to 150 kΩ	2312 663 4....	UXAAxxxxxxA1A	–	1000; ammopack
	±0.01	200.0 Ω to 150 kΩ	2312 663 7....	UXAAxxxxxxT1A	–	1000; ammopack

NAFTA ordering information

Cross reference

TYPE	TOL. (%)	RESISTANCE RANGE	12NC	NAFTA PART NUMBER[1]	TAPING (mm)	SPQ (units)
UXA0204-02	±0.10	100.0 Ω to 100 kΩ	2312 664 3....	UXATxxxxxxB1A	–	1000; ammopack
	±0.05	150.0 Ω to 100 kΩ	2312 664 4....	UXATxxxxxxA1A	–	1000; ammopack
	±0.01	200.0 Ω to 100 kΩ	2312 664 7....	UXATxxxxxxT1A	–	1000; ammopack
UXB0207 ULTRA PRECISION						
UXB0207-10	±0.25	22.0 Ω to 301 kΩ	2312 577 2....	UXBBxxxxxxC5T	–	5000; tape & reel
			2312 672 2....	UXBBxxxxxxC1A	–	1000; ammopack
	±0.10	40.2 Ω to 301 kΩ	2312 577 3....	UXBBxxxxxxB5T	–	5000; tape & reel
			2312 672 3....	UXBBxxxxxxB1A	–	1000; ammopack
	±0.05	100.0 Ω to 301 kΩ	2312 577 4....	UXBBxxxxxxA5T	–	5000; tape & reel
			2312 672 4....	UXBBxxxxxxA1A	–	1000; ammopack
	±0.01	200.0 Ω to 301 kΩ	2312 577 7....	UXBBxxxxxxT5T	–	5000; tape & reel
			2312 672 7....	UXBBxxxxxxT1A	–	1000; ammopack
UXB0207-05	±0.25	47.0 Ω to 221 kΩ	2312 578 2....	UXBAxxxxxxC5T	–	5000; tape & reel
			2312 673 2....	UXBAxxxxxxC1A	–	1000; ammopack
	±0.10	47.0 Ω to 221 kΩ	2312 578 3....	UXBAxxxxxxB5T	–	5000; tape & reel
			2312 673 3....	UXBAxxxxxxB1A	–	1000; ammopack
	±0.05	100.0 Ω to 221 kΩ	2312 578 4....	UXBAxxxxxxA5T	–	5000; tape & reel
			2312 673 4....	UXBAxxxxxxA1A	–	1000; ammopack
	±0.01	200.0 Ω to 221 kΩ	2312 578 7....	UXBAxxxxxxT5T	–	5000; tape & reel
			2312 673 7....	UXBAxxxxxxT1A	–	1000; ammopack
UXB0207-02	±0.10	100.0 Ω to 150 kΩ	2312 579 3....	UXBTxxxxxxB5T	–	5000; tape & reel
			2312 674 3....	UXBTxxxxxxB1A	–	1000; ammopack
	±0.05	150.0 Ω to 150 kΩ	2312 579 4....	UXBTxxxxxxA5T	–	5000; tape & reel
			2312 674 4....	UXBTxxxxxxA1A	–	1000; ammopack
	±0.01	200.0 Ω to 150 kΩ	2312 579 7....	UXBTxxxxxxT5T	–	5000; tape & reel
			2312 674 7....	UXBTxxxxxxT1A	–	1000; ammopack
SFR25/25H/16S STANDARD						
SFR25	±5	0.22 Ω to 10 MΩ	2306 181 63...	5043EMxxxxxJ12AFX	52	5000; tape & reel
			2322 181 43...	2322 181 43xxx	52	5000; ammopack
SFR25 jumper[2]	–	0.22 Ω to 10 MΩ	2306 181 90011	5043EM0R000J12AFX	52	5000; tape & reel
			2322 181 90019	5043EM0R000J18AFX	52	5000; ammopack
SFR25H	±5	0.22 Ω to 10 MΩ	2306 186 63...	5053HMxxxxxJ12AFX	52	5000; tape & reel
			2322 186 76...	2322 186 76xxx	52	5000; ammopack
SFR16S	±5	1 Ω to 3 MΩ	2306 187 23...	5033EMxxxxxJ12AFX	52.5	5000; tape & reel
			2322 187 53...	2322 187 53xxx	52.5	5000; ammopack
SFR16S jumper[2]	–	1 Ω to 3 MΩ	2306 187 90013	2306 187 90013	52.5	5000; ammopack

NAFTA ordering information

Cross reference

TYPE	TOL. (%)	RESISTANCE RANGE	12NC	NAFTA PART NUMBER[1]	TAPING (mm)	SPQ (units)
NFR25/25H FUSIBLE						
NFR25	±5	1 to 13 Ω	2322 205 23...	5063FMxxxxxJ12AFX	52	5000; tape & reel
		15 Ω to 15 kΩ	2322 205 23...	5063FDxxxxxJ12AFX	52	5000; tape & reel
		1 to 13 Ω	2322 205 33...	5063FMxxxxxJ18AFX	52	5000; ammopack
		15 Ω to 15 kΩ	2322 205 33...	5063FDxxxxxJ18AFX	52	5000; ammopack
		1 Ω to 15 kΩ	2306 204 03...	2306 204 03xxx	radial	4000; ammopack
NFR25H	±5	1 Ω to 15 kΩ	2306 207 03...	2306 207 03xxx	radial	4000; tape & reel
			2322 207 23...	2322 207 23xxx	52	5000; tape & reel
			2322 207 33...	2322 207 33xxx	52	5000; ammopack
VR25/37/68 HIGH VOLTAGE/HIGH OHMIC						
VR25	±5	100 kΩ to 15 MΩ	2322 241 23...	5043DMxxxxxJ12AFX	52	5000; tape & reel
			2322 241 13...	5043DMxxxxxJ08AFX	52	1000; ammopack
	±10	15 MΩ to 22 MΩ	2322 241 22...	2322 241 22xxx	52	5000; tape & reel
			2322 241 12...	2322 241 12xxx	52	1000; ammopack
	±1	100 kΩ to 15 MΩ	2322 241 8....	5043DMxxxxxF08AF5	52	1000; ammopack
VR37	±5	100 kΩ to 33 MΩ	2322 242 23...	5053DMxxxxxJ12AFX	52	5000; tape & reel
			2322 242 13...	5053DMxxxxxJ08AFX	52	1000; ammopack
	±1		2322 242 8....	5053DMxxxxxF08AF5	52	1000; ammopack
VR68	±5	100 kΩ to 68 MΩ	2322 244 13...	5073DMxxxxxJ08AFX	66.7	500; ammopack
	±1		2322 244 8...	5073DMxxxxxF08AF5	66.7	500; ammopack
PR01/02/03 POWER						
PR01	±5	0.22 Ω to 1 MΩ	2306 197 23...	5073NWxxxxxJ12AFX	52	5000; tape & reel
			2322 193 13...	5073NWxxxxxJA8AFX	73	1000; ammopack
	±1		2306 191 5....	5073NWxxxxxF12AF5	52	5000; tape & reel
			2306 191 1....	5073NWxxxxxFA8AF5	73	1000; ammopack
	±5		2306 197 03...	2306 197 03xxx	radial	4000; ammopack
PR02	±5	0.33 Ω to 1 MΩ	2306 198 23...	5083NWxxxxxJ12AFX	52	5000; tape & reel
			2322 194 13...	5083NWxxxxxJA8AFX	73	1000; ammopack
	±1		2306 192 5....	5083NWxxxxxF12AF5	52	5000; tape & reel
			2306 192 1....	5083NWxxxxxFA8AF5	73	1000; ammopack
	±5		2306 198 03...	2306 198 03xxx	radial	3000; ammopack
PR03	±5	0.68 Ω to 1 MΩ	2322 195 13...	5093NWxxxxxJ08AFX	80	500; ammopack
	±1		2306 193 5....	5093NWxxxxxF08AF5	80	500; ammopack

NAFTA ordering information

Cross reference

TYPE	TOL. (%)	RESISTANCE RANGE	12NC	NAFTA PART NUMBER[1]	TAPING (mm)	SPQ (units)
AC01/03/04/05/07/10/15/20 CEMENTED WIREWOUND						
AC01	±5	0.1 Ω to 2 kΩ	2306 328 33...	AC01WxxxxxJ	63	1000; ammopack
AC03		0.1 Ω to 4.7 kΩ	2322 329 03...	AC03WxxxxxJ	63	500; ammopack
AC04		0.1 Ω to 6.8 kΩ	2322 329 04...	AC04WxxxxxJ	63	500; ammopack
AC05		0.1 Ω to 8.2 kΩ	2322 329 05...	AC05WxxxxxJ	63	500; ammopack
AC07		0.1 Ω to 15 kΩ	2322 329 07...	AC07WxxxxxJ	74	500; ammopack
AC10		0.68 Ω to 27 kΩ	2322 329 10...	AC10WxxxxxJ	74	500; ammopack
AC15		0.82 Ω to 39 kΩ	2322 329 15...	AC15WxxxxxJ	–	100; bulk
AC20		1.2 Ω to 56 kΩ	2322 329 20...	AC20WxxxxxJ	–	100; bulk
SMW/SMF02/03/05 ENCASED WIREWOUND						
SMW02	±5	0.1 to 200 Ω	2306 340 03...	SMW02WxxxxxJ	–	500; loose in box
SMW03		0.1 to 560 Ω	2306 341 03...	SMW03WxxxxxJ	–	500; loose in box
SMW05			2306 342 03...	SMW05WxxxxxJ	–	500; loose in box
SMF02		220 Ω to 47 kΩ	2306 345 03...	SMF02WxxxxxJ	–	500; loose in box
SMF03		620 Ω to 47 kΩ	2306 346 03...	SMF03WxxxxxJ	–	500; loose in box
SMF05			2306 347 03...	SMF05WxxxxxJ	–	500; loose in box
PAC01/02/03/04/05/06 PRECISION WIREWOUND						
PAC01	±1	0.22 Ω to 2.2 kΩ	2306 327 5....	PAC01DxxxxxF	63	1000; ammopack
PAC02		0.10 Ω to 3.6 kΩ	2306 327 0....	PAC02DxxxxxF	63	500; ammopack
PAC03		0.10 Ω to 4.7 kΩ	2306 327 1....	PAC03DxxxxxF	63	500; ammopack
PAC04		0.10 Ω to 8.2 kΩ	2306 327 2....	PAC04DxxxxxF	71	500; ammopack
PAC05		0.68 Ω to 10 kΩ	2307 327 3....	PAC05DxxxxxF	71	500; ammopack
PAC06		0.68 Ω to 12 kΩ	2308 327 4....	PAC06DxxxxxF	71	500; ammopack

Notes

1. In clear text code part numbers, the ohmic value of the resistor is represented by 4-digits for MELFs, 6-digits for UX series and 5-digits for all other resistors; see Table 2.
2. The jumper has a maximum resistance R_{max} = 10 mΩ at 5 A.

NAFTA ordering information

Cross reference

Composition of the clear text code

- The resistors have an ordering code starting with 50 or product type (AC, PAC, etc)
- The subsequent digits indicate the resistor type, temperature coefficient, ohmic value, tolerance and packaging; see Table 1
- The ohmic value is represented by 4, 5 or 6 digits; see Table 2
- For temperature coefficient and tolerance, see Table 3.

Table 2 Examples of the ohmic value

VALUE	4 DIGITS (MELF)	5 DIGITS (ALL OTHER)	6 DIGITS (ÜX SERIES)
1 Ω	1R00	1R000	01R000
10 Ω	10R0	10R00	10R000
100 Ω	1000	100R0	100R00
1 kΩ	1001	1K000	01K000
10 kΩ	1002	10K00	10K000
100 kΩ	1003	100K0	100K00
1 MΩ	1004	1M000	01M000

Table 3 Letter coding for temperature coefficient and tolerance

TC ($\times 10^{-6}$/K)	LETTER CODE	TOL. (%)	LETTER CODE
200	M	±10	K
100	D	±5	J
50	C	±1	F
25	E	±0.50	D
15	F	±0.25	C
10	B	±0.10	B
5	A	±0.05	A
2	T	±0.025	Z
–	–	±0.02	H
–	–	±0.01	T

ORDERING EXAMPLE: CLEAR TEXT CODE

The ordering code of a SFR25 resistor, value 5600 Ω ±5%, taped on a bandolier of 5000 units in tape on reel is: 5043EM5K600J12AFX.

Composition of the 12NC

- The resistors have a 12-digit ordering code starting with 23
- The subsequent 7 digits indicate the resistor type and packaging; see Table 1.
- The remaining digits indicate the resistance value:
  - The first 2 or 3 digits indicate the resistance value.
  - The last digit indicates the resistance decade in accordance with Tables 4 or 5.

Table 4 Last digit for **±5%** and **±10%** 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

Table 5 Last digit for **±1%** tolerance

RESISTANCE DECADE	LAST DIGIT
0.10 to 0.976 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 to 9.76 MΩ	5
≥10 MΩ	6

ORDERING EXAMPLE: 12NC

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

DATA HANDBOOK SYSTEM

DATA HANDBOOK SYSTEM

BCcomponents data handbooks are available for selected product ranges and contain all relevant data available at the time of publication. Each handbook is revised and updated regularly.

Loose data sheets are sent to subscribers to keep them up-to-date on additions or alterations made during the lifetime of each edition.

Our data handbook titles are listed here.

BC01	Electrolytic Capacitors
BC02	Non-linear Resistors
BC03	Variable Resistors
BC04	Variable Capacitors
BC05	Film Capacitors
BC06	Leaded Ceramic Capacitors
BC08	Linear Resistors

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STANDARD SERIES OF VALUES IN A DECADE FOR RESISTANCES AND CAPACITANCES

In accordance with *"IEC publication 60 063"*.

E192	E96	E48	E192	E96	E48	E192	E96	E48	E192	E96	E48
100	100	100	178	178	178	316	316	316	562	562	562
101			180			320			569		
102	102		182	182		324	324		576	576	
104			184			328			583		
105	105	105	187	187	187	332	332	332	590	590	590
106			189			336			597		
107	107		191	191		340	340		604	604	
109			193			344			612		
110	110	110	196	196	196	348	348	348	619	619	619
111			198			352			626		
113	113		200	200		357	357		634	634	
114			203			361			642		
115	115	115	205	205	205	365	365	365	649	649	649
117			208			370			657		
118	118		210	210		374	374		665	665	
120			213			379			673		
121	121	121	215	215	215	383	383	383	681	681	681
123			218			388			690		
124	124		221	221		392	392		698	698	
126			223			397			706		
127	127	127	226	226	226	402	402	402	715	715	715
129			229			407			723		
130	130		232	232		412	412		732	732	
132			234			417			741		
133	133	133	237	237	237	422	422	422	750	750	750
135			240			427			759		
137	137		243	243		432	432		768	768	
138			246			437			777		
140	140	140	249	249	249	442	442	442	787	787	787
142			252			448			796		
143	143		255	255		453	453		806	806	
145			258			459			816		
147	147	147	261	261	261	464	464	464	825	825	825
149			264			470			835		
150	150		267	267		475	475		845	845	
152			271			481			856		
154	154	154	274	274	274	487	487	487	866	866	866
156			277			493			876		
158	158		280	280		499	499		887	887	
160			284			505			898		
162	162	162	287	287	287	511	511	511	909	909	909
164			291			517			920		
165	165		294	294		523	523		931	931	
167			298			530			942		
169	169	169	301	301	301	536	536	536	953	953	953
172			305			542			965		
174	174		309	309		549	549		976	976	
176			312			556			988		

E24	E12	E6	E3
10	10	10	10
11			
12	12		
13			
15	15	15	
16			
18	18		
20			
22	22	22	22
24			
27	27		
30			
33	33	33	
36			
39	39		
43			
47	47	47	47
51			
56	56		
62			
68	68	68	
75			
82	82		
91			

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BCB10

Printed in The Netherlands 2000 4459 001-1 Date of release: November 2000

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