

## Precision chip resistors sizes 1206, 0805 and 0603

### RC02/12/22

#### FEATURES

- Low assembly costs
- High component and equipment reliability
- Excellent performance at high frequency, especially the RC22.
- TC 50 in thick film technology
- Complete precision SMD family.

#### APPLICATIONS

- All general purpose applications.

#### DESCRIPTION

The resistors are constructed on a high grade ceramic body (aluminium oxide). Internal metal electrodes are added at each end and connected by a resistive paste which is applied to the top surface of the substrate. The composition of the paste is adjusted to give the approximate resistance required and the value is trimmed to within tolerance, by laser cutting of this resistive layer.

The resistive layer is covered with a protective coat and printed with the resistance value (no printing on RC22). Finally, the two external end terminations are added. For ease of soldering the outerlayer of these end terminations is a lead/tin alloy.

#### QUICK REFERENCE DATA

DESCRIPTION	VALUE				
	RC02H	RC02G	RC12H	RC12G	RC22H
Size code	1206 (3216)		0805 (2012)		0603 (1608)
Resistance range	1 Ω to 10 MΩ	100 Ω to 1 MΩ	1 Ω to 10 MΩ	100 Ω to 1 MΩ	1 Ω to 10 MΩ
Resistance tolerance and E-series	±1%; E24/E96 series				
Temperature coefficient; note 1:					
1 Ω ≤ R < 5 Ω	≤ ±250	–	≤ ±250	–	≤ ±250
5 Ω ≤ R < 10 Ω	≤ ±200	–	≤ ±200	–	≤ ±200
10 Ω ≤ R < 100 Ω	≤ ±100	–	≤ ±100	–	≤ ±100
100 Ω ≤ R ≤ 1 MΩ	≤ ±100	≤ ±50	≤ ±100	≤ ±50	≤ ±100
1 MΩ < R ≤ 10 MΩ	≤ ±200	–	≤ ±200	–	≤ ±200
Maximum dissipation at T <sub>amb</sub> = 70 °C	0.25 W		0.125 W		0.063 W
Maximum permissible voltage	200 V (DC or RMS)		150 V (DC or RMS)		50 V (DC or RMS)
Climatic category (IEC 68)	55/155/56	55/125/56	55/155/56	55/125/56	55/155/56
Basic specification	IEC 115-8				
Stability after:					
load, 1000 hours at T <sub>amb</sub> = 70 °C:					
1 Ω ≤ R ≤ 1 MΩ	ΔR/R max.: ±1.0% +0.05 Ω				
R > 1 MΩ	ΔR/R max.: ±1.5% +0.05 Ω				
climatic tests:					
1 Ω ≤ R ≤ 1 MΩ	ΔR/R max.: ±1.0% +0.05 Ω				
R > 1 MΩ	ΔR/R max.: ±1.5% +0.05 Ω				
resistance to soldering heat	ΔR/R max.: ±0.5% +0.05 Ω				
short time overload	ΔR/R max.: ±1.0% +0.05 Ω				

#### Note

1. All TC values should be multiplied by 10<sup>-6</sup>/K.

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**ORDERING INFORMATION**

**Table 1** Ordering code indicating type and packaging

TYPE	ORDERING CODE 2322 ... ..				
	CARDBOARD TAPE ON REEL			EMBOSSED CARRIER TAPE ON REEL	
	5000 units	10000 units	20000 units	5000 units	10000 units
RC02H	724 6....	724 7....	724 8....	724 2....	724 4....
RC02G	722 2....	722 3....	–	723 6....	723 7....
RC12H	734 6....	734 7....	734 8....	734 2....	734 4....
RC12G	732 6....	732 7....	–	733 6....	733 7....
RC22H	704 6....	704 7....	704 8....	–	–
<b>Jumper 0 Ω</b>					
RC02H; note 1	724 92006	724 92007	–	724 92002	724 92004
RC12H; note 1	734 92006	734 92007	–	734 92002	734 92004
RC22H; note 2	704 92006	704 92007	–	–	–

**Notes**

1. The jumper has a maximum resistance  $R_{max} = 50 \text{ m}\Omega$  and a rated current  $I_R = 2 \text{ A}$ .
2. The jumper has a maximum resistance  $R_{max} = 50 \text{ m}\Omega$  and a rated current  $I_R = 1 \text{ A}$ .

**Ordering code (12NC)**

- The resistors have a 12-digit ordering code starting with 2322.
- The subsequent 4 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 2** Last digit of 12NC

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

**Type designation**

SIZE	TYPE	TC SERIES
1206	RC02H	100
	RC02G	50
0805	RC12H	100
	RC12G	50
0603	RC22H	100

**ORDERING EXAMPLE**

The ordering code of a RC02H resistor, value 4750 Ω, supplied on cardboard tape of 5000 units per reel is: 2322 724 64752.

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## FUNCTIONAL DESCRIPTION

### Product characterization

Standard values of nominal resistance are taken from the E24/E96 series for resistors with a tolerance of  $\pm 1\%$ . The values of the E24/96 series are in accordance with "IEC publication 63".

### Limiting values

TYPE	LIMITING VOLTAGE <sup>(1)</sup> (V)	LIMITING POWER (W)
RC02	200	0.25
RC12	150	0.125
RC22	50	0.063

### Note

1. This is the maximum voltage that may be continuously applied to the resistor element, see "IEC publication 115-8".

## DERATING

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

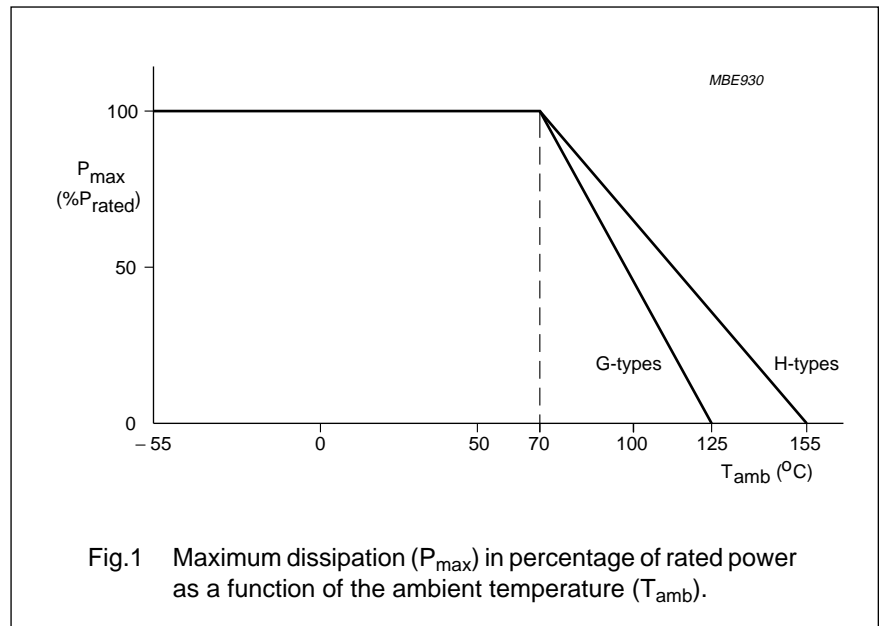
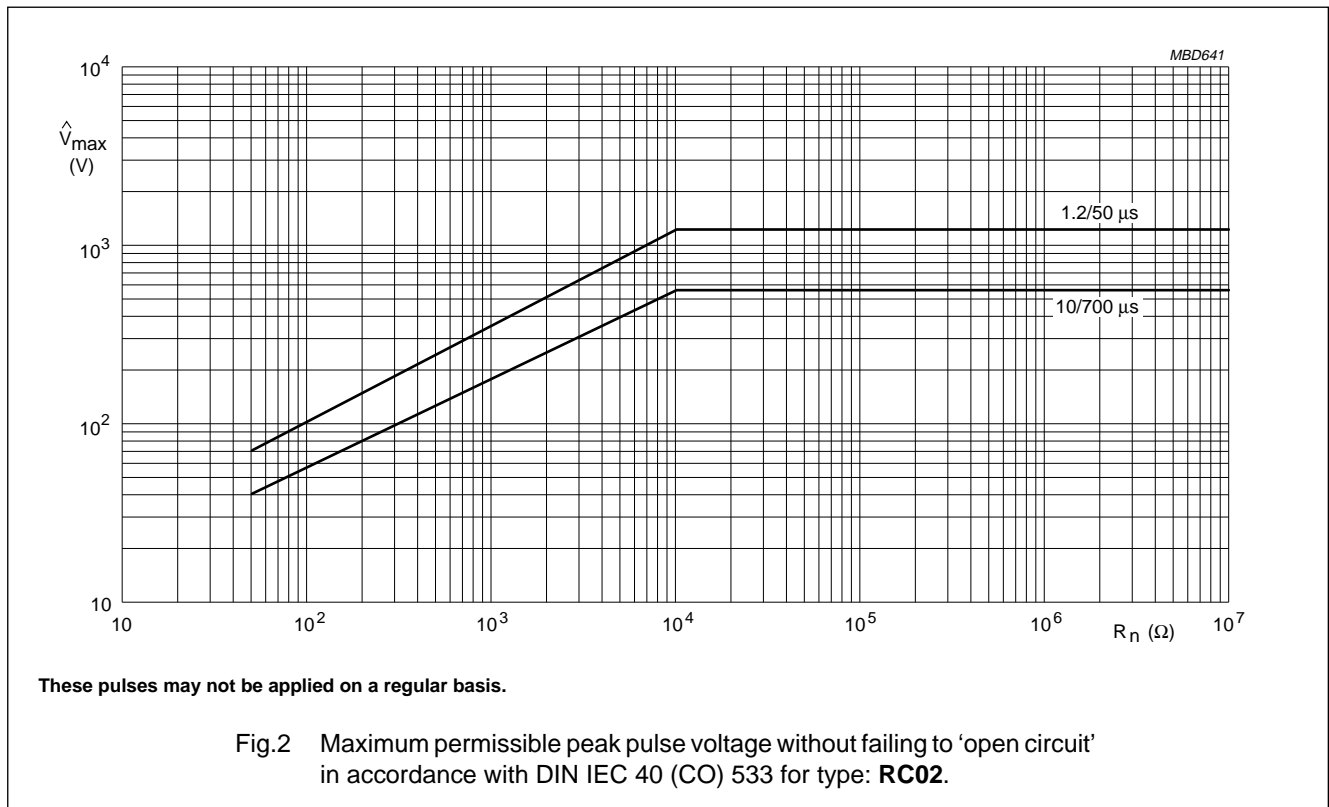


Fig.1 Maximum dissipation ( $P_{max}$ ) in percentage of rated power as a function of the ambient temperature ( $T_{amb}$ ).

## PULSE LOADING CAPABILITIES

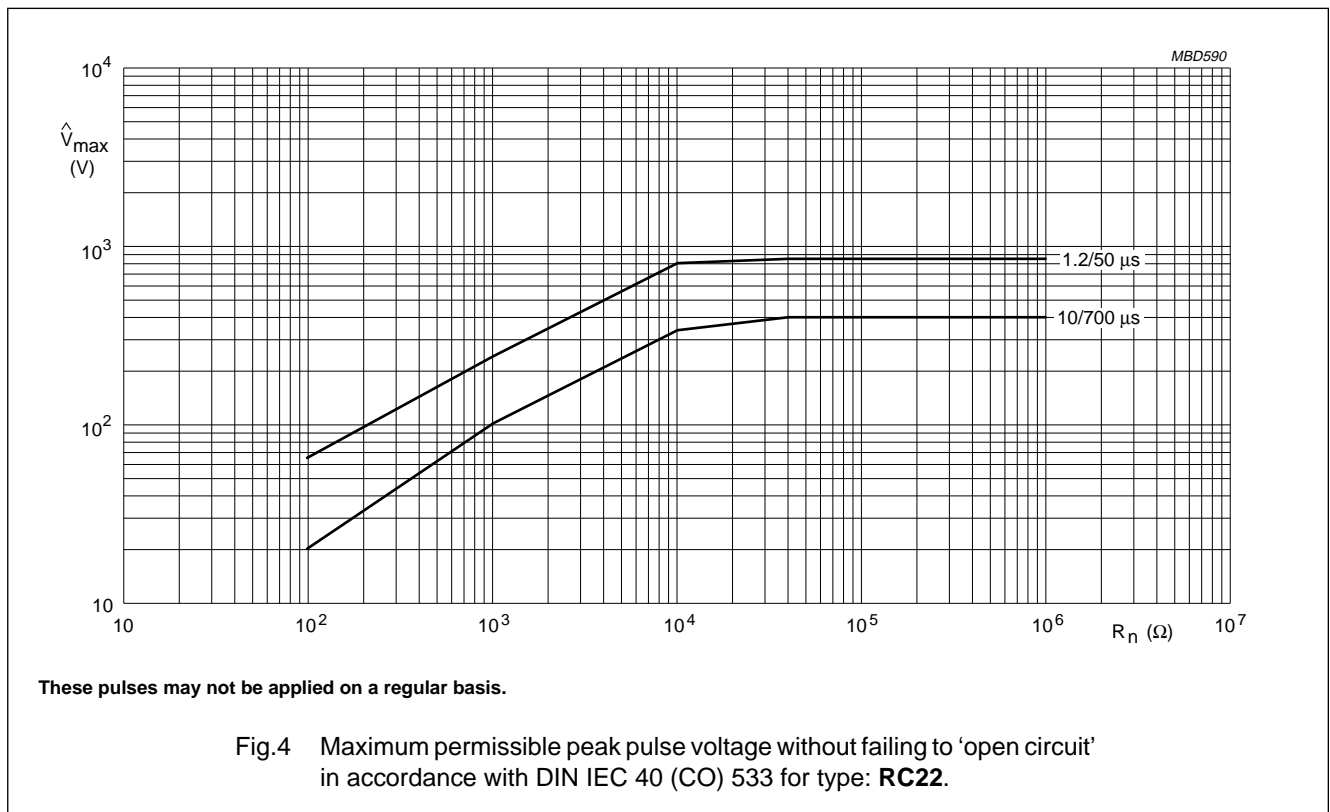
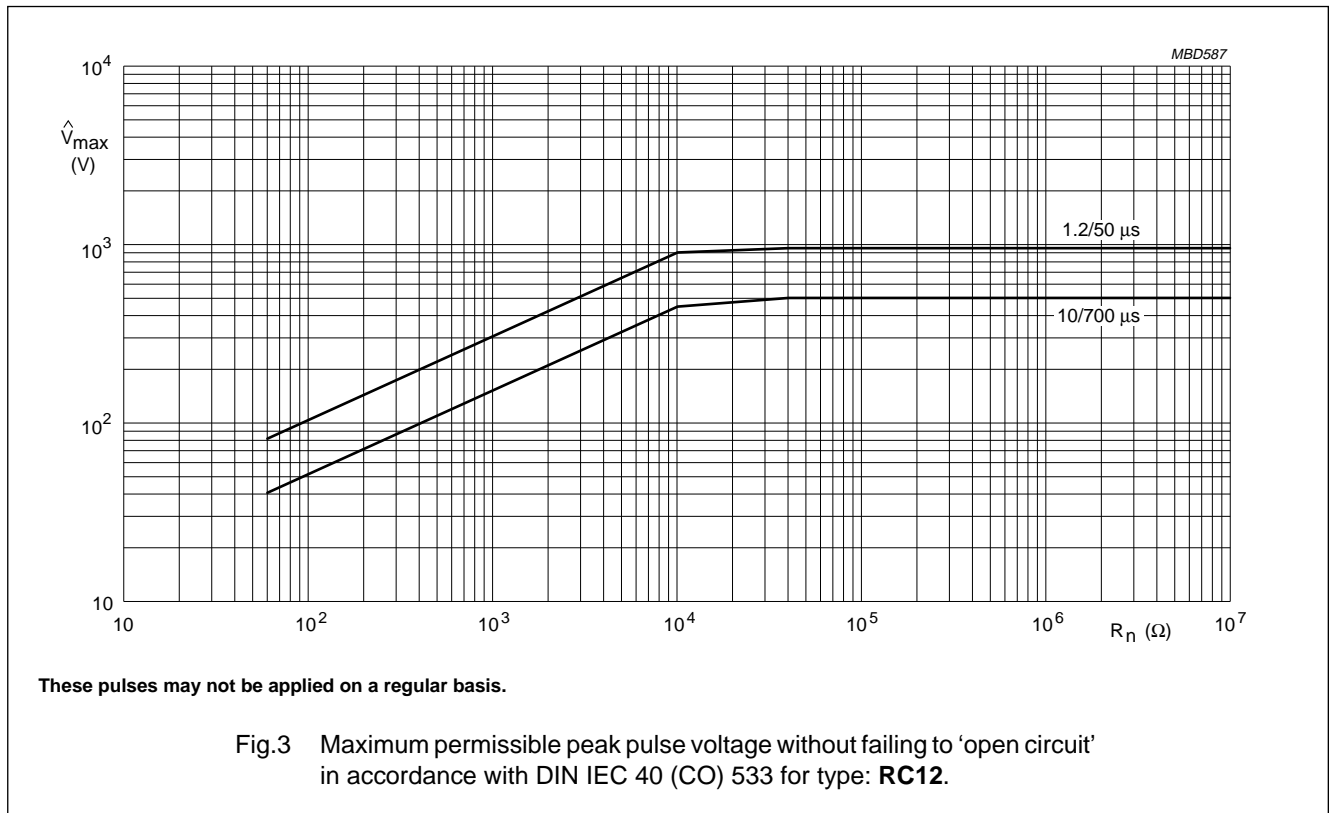


These pulses may not be applied on a regular basis.

Fig.2 Maximum permissible peak pulse voltage without failing to 'open circuit' in accordance with DIN IEC 40 (CO) 533 for type: RC02.

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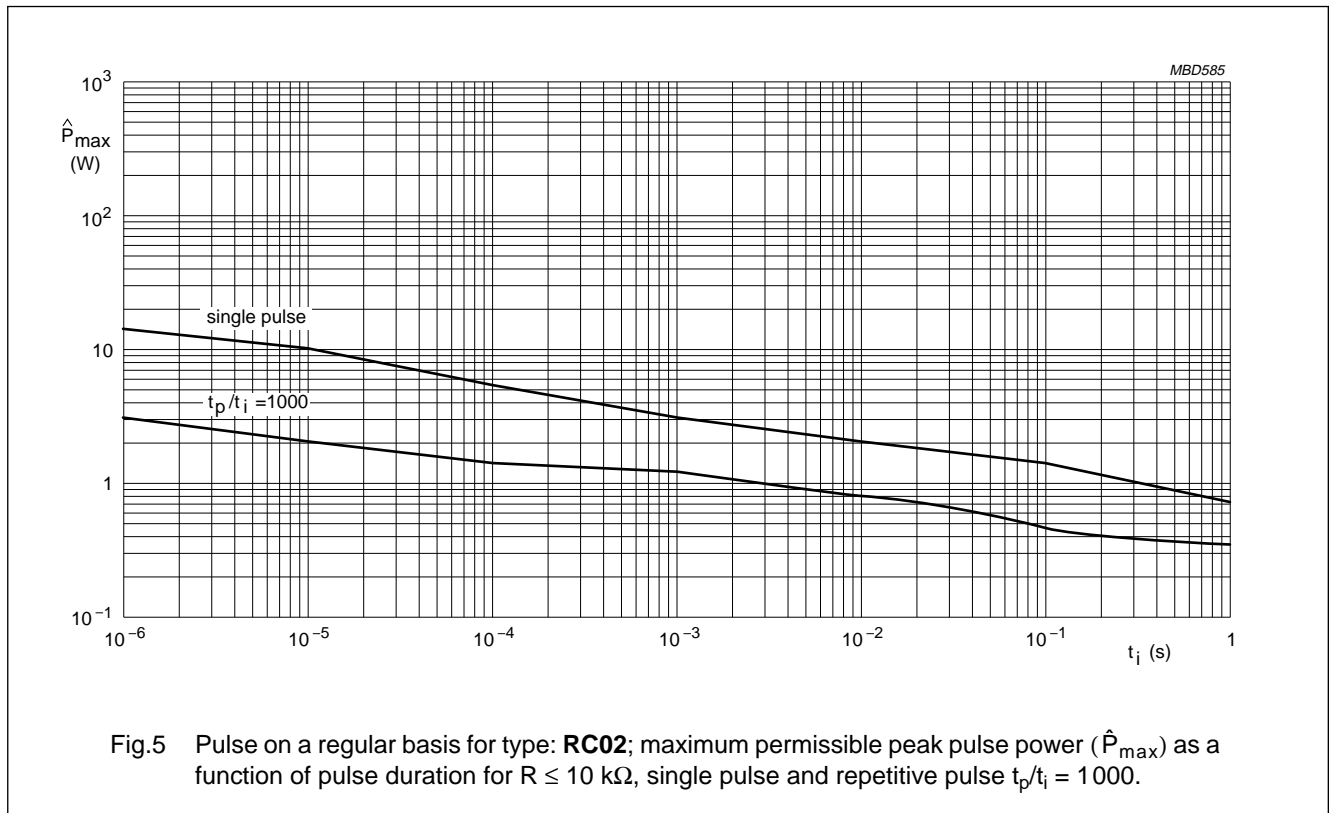


Fig.5 Pulse on a regular basis for type: **RC02**; maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration for  $R \leq 10 \text{ k}\Omega$ , single pulse and repetitive pulse  $t_p/t_i = 1000$ .

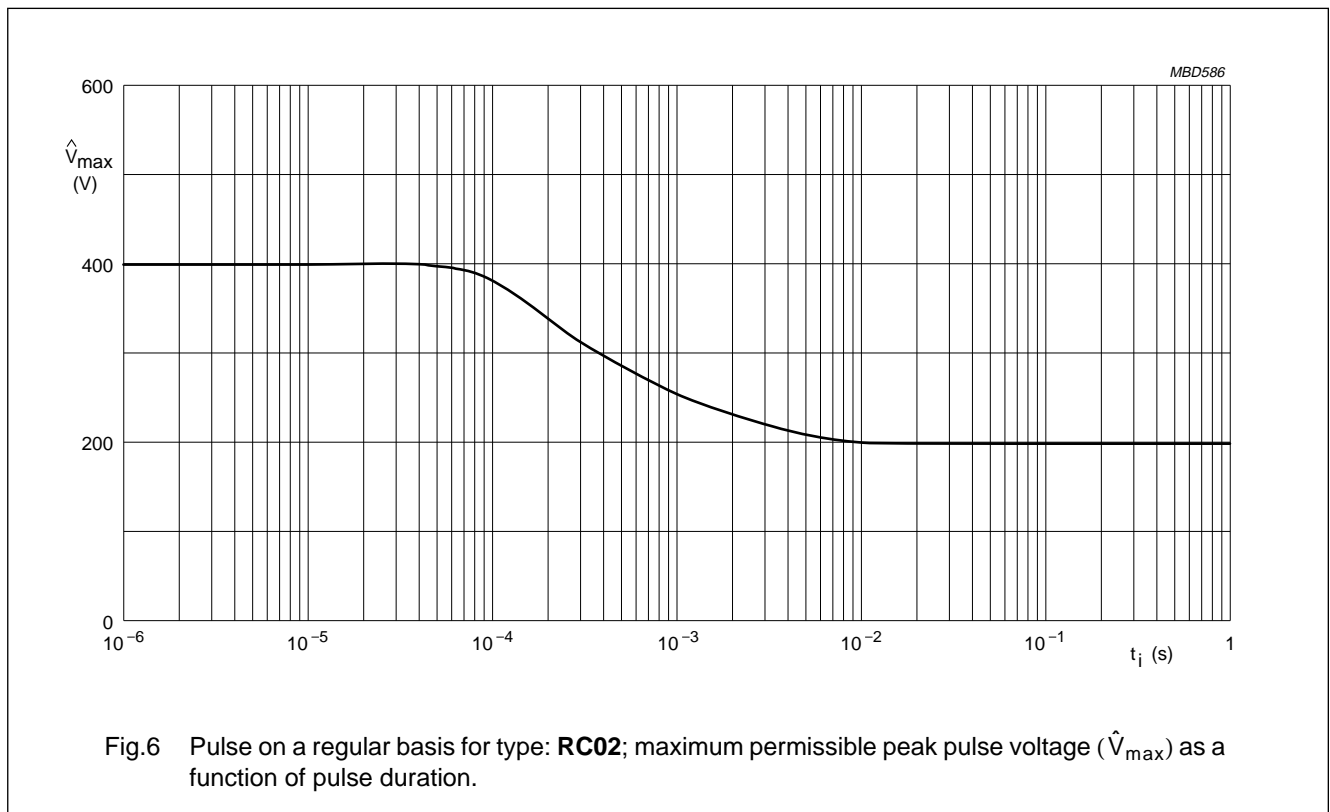


Fig.6 Pulse on a regular basis for type: **RC02**; maximum permissible peak pulse voltage ( $\hat{V}_{max}$ ) as a function of pulse duration.

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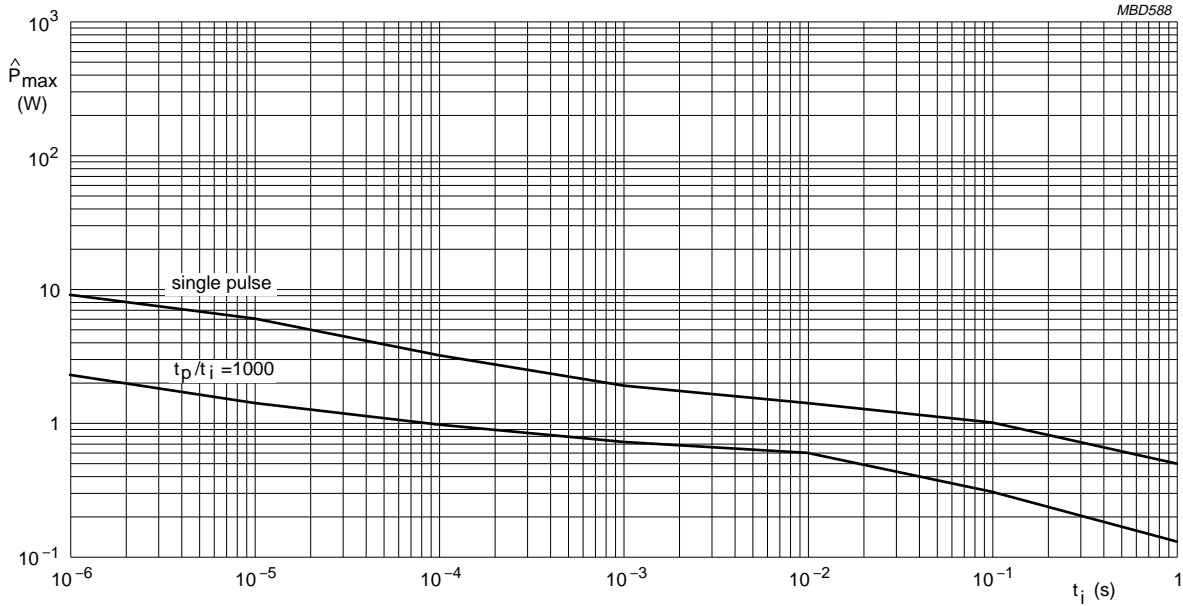


Fig.7 Pulse on a regular basis for type: **RC12**; maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration for  $R \leq 10$  k $\Omega$ , single pulse and repetitive pulse  $t_p/t_i = 1000$ .

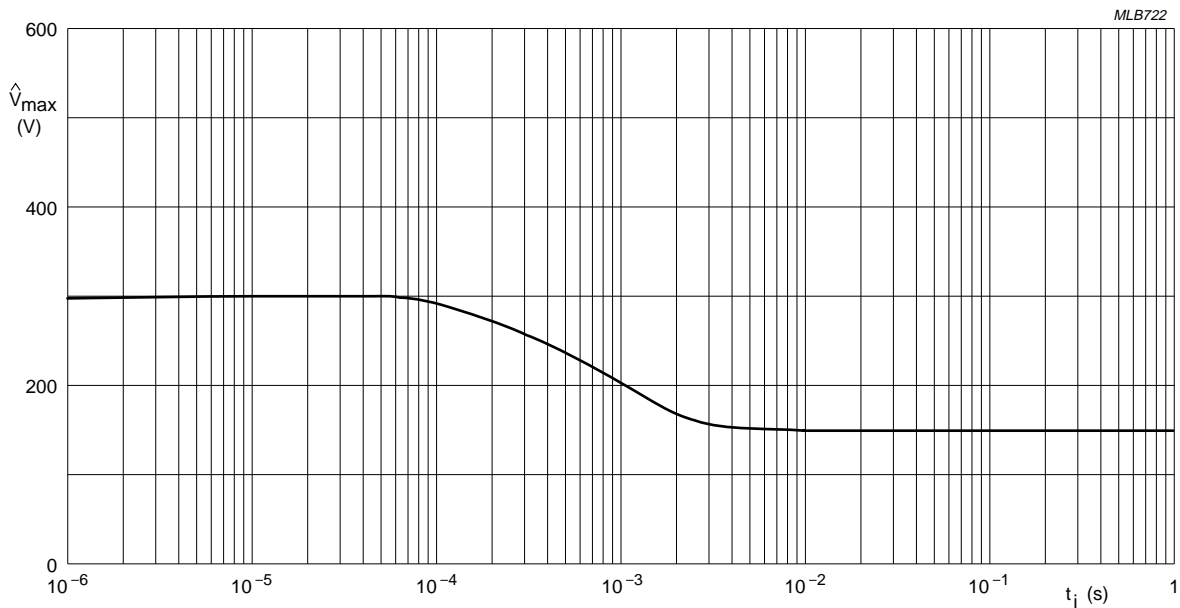
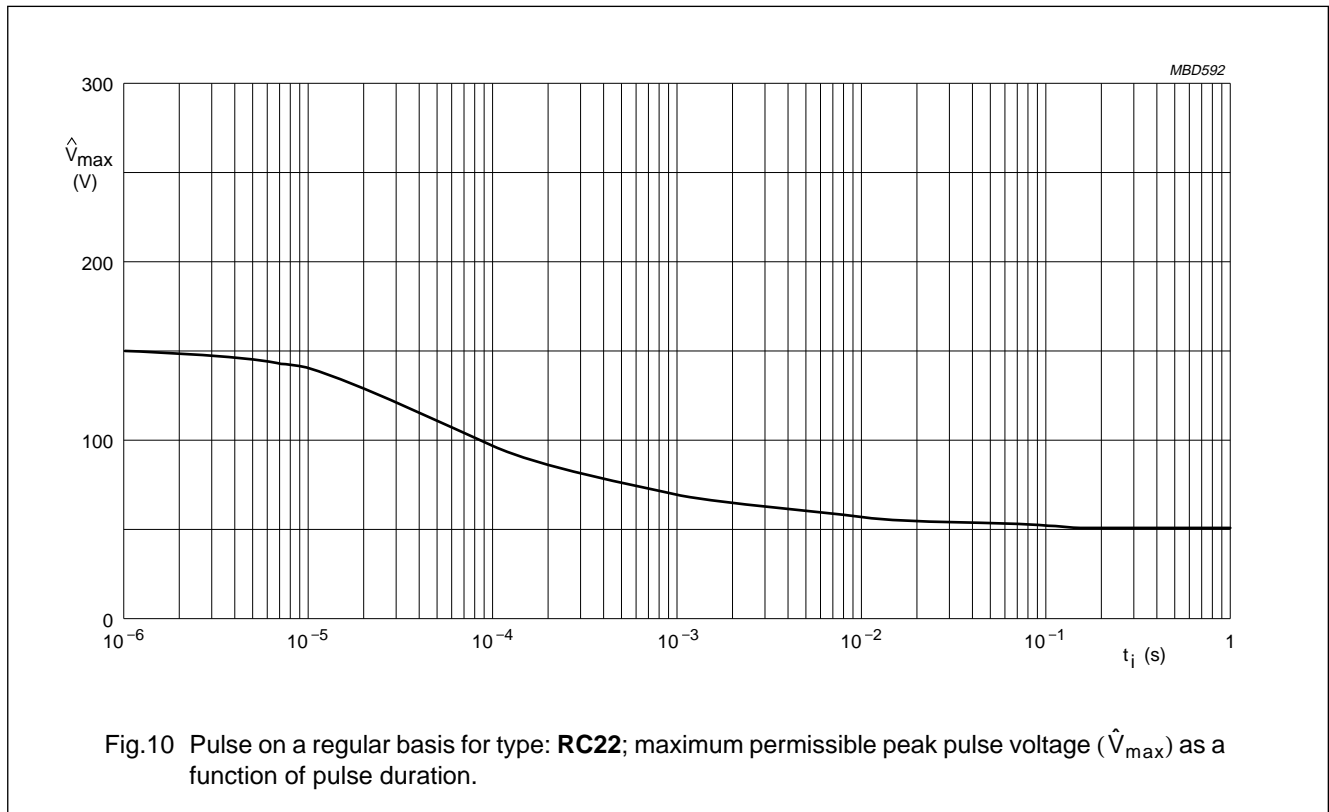
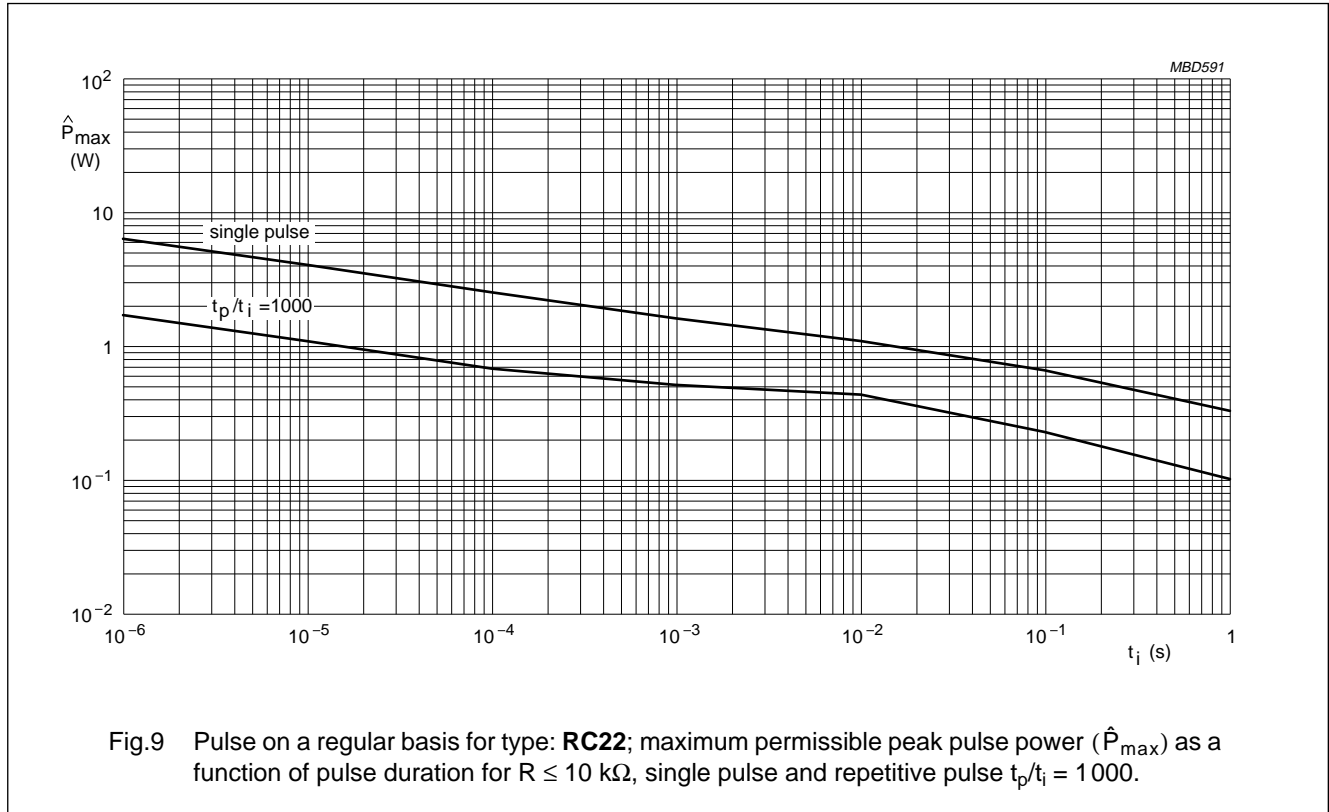


Fig.8 Pulse on a regular basis for type: **RC12**; maximum permissible peak pulse voltage ( $\hat{V}_{max}$ ) as a function of pulse duration.

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**MECHANICAL DATA**

**Mass per 100 units**

TYPE	MASS (g)
RC02	1.0
RC12	0.55
RC22	0.25

**Marking**

All resistors except RC22 are marked with a four digit code on the protective coat to designate the nominal resistance value.

**4-DIGIT MARKING**

For values up to 976 Ω the R is used as a decimal point. For values of 1 kΩ or greater the first 3 digits apply to the resistance value and the fourth indicates the number of zeros to follow.

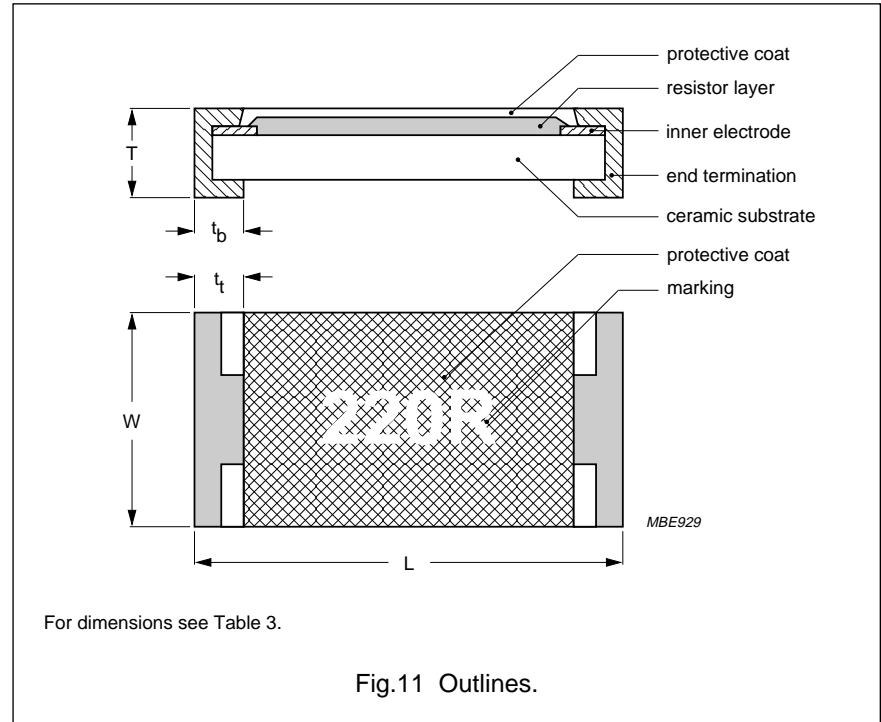
**Example**

MARKING	RESISTANCE
121R	121 Ω
4021	4.02 kΩ
1503	150 kΩ

**PACKAGE MARKING**

The packaging of all resistors including RC22 is also marked and includes resistance value, tolerance, TC value, catalogue number, quantity, production period, batch number and source code.

**Outlines**



**Table 3** Chip resistor types and relevant physical dimensions; see Fig.11

TYPE	L (mm)	W (mm)	T (mm)	t <sub>t</sub> (mm)	t <sub>b</sub> (mm)
RC02	3.20 +0.10/-0.20	1.60 ±0.15	0.55 ±0.10	0.45 ±0.25	0.50 ±0.25
RC12	2.00 ±0.15	1.25 ±0.15	0.55 ±0.10	0.40 ±0.20	0.40 ±0.20
RC22	1.60 ±0.10	0.80 +0.15/-0.05	0.45 ±0.10	0.30 ±0.20	0.30 ±0.20



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## TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 115-8", category **LCT/UCT/56** (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, **56** days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 68, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to "IEC 68-1", subclause 5.3.

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).

In Table 4 the tests and requirements are listed with reference to the relevant clauses of "IEC publications 115-8 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 115-8 CLAUSE	IEC 68-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS				
					RC02H	RC02G	RC12H	RC12G	RC22H
<b>Tests in accordance with the schedule of IEC publication 115-8</b>									
4.4.1		visual examination			no holes; clean surface; no damage				
4.4.2		dimensions (outline; see Fig.11)	gauge (mm)		0.45 ≤ T ≤ 0.65 1.45 ≤ W ≤ 1.75 3.0 ≤ L ≤ 3.3	0.45 ≤ T ≤ 0.65 1.10 ≤ W ≤ 1.40 1.85 ≤ L ≤ 2.15	0.35 ≤ T ≤ 0.55 0.75 ≤ W ≤ 0.95 1.50 ≤ L ≤ 1.70		
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 <sub>nom</sub> : max. ±1%				
4.18	20 (Ta)	resistance to soldering heat	unmounted chips; 10 s; 260 ±5 °C		no visual damage ΔR/R max.: ±0.5% +0.05 Ω				
4.29	45 (Xa)	component solvent resistance	isopropyl alcohol or H <sub>2</sub> O followed by brushing in accordance with "MIL 202 F"		no visual damage				

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IEC 115-8 CLAUSE	IEC 68-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS				
					RC02H	RC02G	RC12H	RC12G	RC22H
4.17	20 (Ta)	solderability	unmounted chips completely immersed for $2 \pm 0.5$ s in a solder bath at $235 \pm 5$ °C		good tinning ( $\geq 95\%$ covered); no visual damage				
4.7		voltage proof on insulation	maximum voltage (RMS) during 1 minute, metal block method		no breakdown or flashover				
4.13		short time overload	room temperature; $P = 6.25 \times P_n$ ; 5 s ( $V \leq 2 \times V_{max}$ )		$\Delta R/R$ max.: $\pm 1\% + 0.05 \Omega$				
4.33		bending	resistors mounted on a 90 mm glass epoxy resin PCB (FR4), bending: 3 mm for <b>RC02H</b> and <b>RC02G</b> ; 5 mm for <b>RC12H</b> , <b>RC12G</b> and <b>RC22H</b>		no visual damage $\Delta R/R$ max.: $\pm 0.5\% + 0.05 \Omega$				
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles		no visual damage $\Delta R/R$ max.: $\pm 0.5\% + 0.05 \Omega$				
4.23		climatic sequence:							
4.23.3	30 (D)	damp heat (accelerated) 1st cycle							
4.23.6	30 (D)	damp heat (accelerated) remaining cycles	6 days; 55 °C; 95 to 98% RH	$R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	$R_{ins}$ min.: $10^4 \text{ M}\Omega$ $\Delta R/R$ max.: $\pm 1.0\% + 0.05 \Omega$ $\Delta R/R$ max.: $\pm 1.5\% + 0.05 \Omega$				
4.24.2	3 (Ca)	damp heat (steady state) (IEC)	56 days; 40 °C; 90 to 95% RH; loaded with $0.01 P_n$ (IEC steps: 4 to 100 V)	$R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	$\Delta R/R$ max.: $\pm 1.0\% + 0.05 \Omega$ $\Delta R/R$ max.: $\pm 1.5\% + 0.05 \Omega$				
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	$R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	$\Delta R/R$ max.: $\pm 1.0\% + 0.05 \Omega$ $\Delta R/R$ max.: $\pm 1.5\% + 0.05 \Omega$				
4.23.2	27 (Ba)	endurance at upper category temperature	1 000 hours; no load	$R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	$\Delta R/R$ max.: $\pm 1.0\% + 0.05 \Omega$ $\Delta R/R$ max.: $\pm 1.5\% + 0.05 \Omega$				

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IEC 115-8 CLAUSE	IEC 68-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS				
					RC02H	RC02G	RC12H	RC12G	RC22H
4.8.4.2		temperature coefficient	at 25/LCT/25 °C and 25/UCT/25 °C ( $TC \times 10^{-6}/K$ )	R < 5 $\Omega$ R < 10 $\Omega$ R < 100 $\Omega$ R ≤ 1 M $\Omega$ R ≤ 10 M $\Omega$	≤ ±250 ≤ ±200 ≤ ±100 ≤ ±100 ≤ ±200	– – – ≤ ±50 –	≤ ±250 ≤ ±200 ≤ ±100 ≤ ±100 ≤ ±200	– – – ≤ ±50 –	≤ ±250 ≤ ±200 ≤ ±100 ≤ ±100 ≤ ±200
<b>Other tests in accordance with IEC 115 clauses and IEC 68 test method</b>									
4.17	20 (Tb)	solderability (after ageing)	8 hours steam or 16 hours 155 °C; unmounted chips completely immersed 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	voltage (DC) after 1 minute, metal block method: 100 V for <b>RC02H, RC02G, RC12H and RC12G</b> , 50 V for <b>RC22H</b>		R <sub>ins</sub> min.: 10 <sup>3</sup> M $\Omega$				
4.12		noise	IEC publication 195 (measured with Quantech - equipment)	R ≤ 1 k $\Omega$ R ≤ 10 k $\Omega$ R ≤ 100 k $\Omega$ R ≤ 1 M $\Omega$	max. 1 $\mu$ V/V max. 3 $\mu$ V/V max. 6 $\mu$ V/V max. 10 $\mu$ V/V				
<b>Other applicable tests</b>									
		humidity load (steady state) (JIS)	1 000 hours; +40 °C; 90 to 95% RH; loaded with P <sub>n</sub> or V <sub>max</sub> ; 1.5 hours on and 0.5 hours off	R ≤ 1 M $\Omega$ R > 1 M $\Omega$	$\Delta R/R$ max.: ±2% +0.1 $\Omega$ $\Delta R/R$ max.: ±3% +0.1 $\Omega$				
		leaching	unmounted chips 60 s; 260 ±5 °C		good tinning; no leaching				
		trio damp heat test	1 000 hours; +85 °C; 85% RH; loaded with 0.1 P <sub>n</sub> or V <sub>max</sub>	R ≤ 1 M $\Omega$ R > 1 M $\Omega$	$\Delta R/R$ max.: ±2% +0.1 $\Omega$ $\Delta R/R$ max.: ±3% +0.1 $\Omega$				