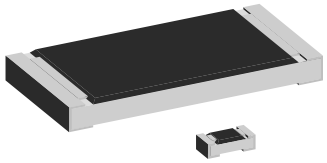
Standard Sulfur Resistant Thick Film Chip Resistor



FEATURES

- Resistance against sulfur containing atmosphere, according to ASTM B809-95 (60 °C, 1000 h)
- Stability at different environmental conditions $\Delta R/R \leq 1$ % (1000 h rated power at 70 °C)
- AEC-Q200 qualified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

HALOGEN FREE

LINKS TO ADDITIONAL RESOURCES

3D Models

The sulfur resistant standard thick film chip resistors are the perfect choice for most fields of modern electronics where high reliability and stability are of major concern. Typical applications include automotive, telecommunications, and industrial.

APPLICATIONS

- Automotive
- ADAS
- Industrial
- Telecommunication

TECHNICAL SPECIFICATIONS

DESCRIPTION	RCA0201-SR e3	RCA0402-SR e3	RCA0603-SR e3	RCA0805-SR e3	RCA1206-SR e3
Imperial size	0201	0402	0603	0805	1206
Metric size code	RR0603M	RR1005M	RR1608M	RR2012M	RR3216M
Resistance range	10 Ω to 1 MΩ; jumper (0 Ω)	10 Ω to 10 MΩ; jumper (0 Ω)			
Resistance tolerance	± 5 %; ± 1 %				
Temperature coefficient	± 200 ppm/K	± 200 ppm/K; ± 100 ppm/K			
Rated dissipation, P_{70} (1)(2)	0.05 W	0.1 W	0.125 W	0.25 W	0.25 W
Operating voltage, $U_{max.}$ AC_{RMS}/DC (2)	30 V	75 V	75 V	150 V	200 V
Permissible film temperature, $\vartheta_{F\ max.}$ (1)	155 °C				
Operating temperature range	-55 °C to +155 °C				
Permissible voltage against ambient (insulation): 1 min, U_{ins}	50 V	100 V	100 V	200 V	300 V
Failure rate: $FIT_{observed}$	≤ 0.1 x 10^{-9}/h				

Notes

(1) Please refer to “Application Information” below

(2) Please refer to table “Maximum Resistance Change at Rated Dissipation and Operating Voltage”, see below

APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. The rated dissipation applies only if the permitted film temperature is not exceeded.

These resistors do not feature a limited lifetime when operated within the permissible limits. However, resistance value drift increasing over operating time may result in exceeding a limit acceptable to the specific application, thereby establishing a functional lifetime.

MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION AND OPERATING VOLTAGE			
OPERATION MODE		**STANDARD**	**EXTENDED**
Rated dissipation, P_{70}	**RCA0402-SR e3**	0.063 W	0.10 W
	RCA0603-SR e3	0.10 W	0.125 W
	RCA0805-SR e3	0.125 W	0.25 W
Operating voltage, $U_{max.}$ AC_{RMS}/DC	**RCA0402-SR e3**	50 V	75 V
	RCA0603-SR e3	75 V	75 V
	RCA0805-SR e3	150 V	150 V
Resistance range		10 Ω to 10 MΩ	
Max. resistance change at P_{70} / $U_{max.}$ AC_{RMS}/DC for resistance range, $\lvert\Delta R/R\rvert$ after [1]:	1000 h	≤ 1 %	≤ 2 %

Note

[1] Applies to components with stability class 1

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
TYPE / SIZE	**TCR**	**TOLERANCE**	**RESISTANCE**	**E-SERIES**
RCA0201-SR e3	± 200 ppm/K	± 5 %	10 Ω to 1 MΩ	E24
	± 200 ppm/K	± 1 %	10 Ω to 1 MΩ	E24; E96
	Jumper, $I_{max.}$ = 1.0 A	≤ 50 mΩ	0 Ω	-
RCA0402-SR e3	± 200 ppm/K	± 5 %	10 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %	10 Ω to 10 MΩ	E24; E96
	Jumper, $I_{max.}$ = 1.5 A	≤ 20 mΩ	0 Ω	-
RCA0603-SR e3	± 200 ppm/K	± 5 %	10 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %	10 Ω to 10 MΩ	E24; E96
	Jumper, $I_{max.}$ = 2.0 A	≤ 20 mΩ	0 Ω	-
RCA0805-SR e3	± 200 ppm/K	± 5 %	10 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %	10 Ω to 10 MΩ	E24; E96
	Jumper, $I_{max.}$ = 2.5 A	≤ 20 mΩ	0 Ω	-
RCA1206-SR e3	± 200 ppm/K	± 5 %	10 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %	10 Ω to 10 MΩ	E24; E96
	Jumper, $I_{max.}$ = 3.5 A	≤ 20 mΩ	0 Ω	-

Note

- The temperature coefficient of resistance (TCR) is not specified for 0 Ω jumpers

PACKAGING

TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS
RCA0201-SR e3	ED = ET7	10 000	Paper tape acc. to IEC 60286-3, Type 1a	8 mm	2 mm	Ø 180 mm / 7"
RCA0402-SR e3	ED = ET7	10 000		8 mm	2 mm	Ø 180 mm / 7"
RCA0603-SR e3	EA = ET1	5000		8 mm	4 mm	Ø 180 mm / 7"
RCA0805-SR e3	EA = ET1	5000		8 mm	4 mm	Ø 180 mm / 7"
RCA1206-SR e3	EA = ET1	5000		8 mm	4 mm	Ø 180 mm / 7"

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: RCA06031K00FKEASR
Part Number: RCA06030000ZSEASR

R	C	A	0	6	0	3	1	K	0	0	F	K	E	A	S	R

TYPE / SIZE	RESISTANCE	TOLERANCE	TCR	PACKAGING	SPECIAL
RCA0201 **RCA0402** **RCA0603** **RCA0805** **RCA1206**	**R** = decimal **K** = thousand **M** = million **0000** = jumper	**F** = ± 1 % **J** = ± 5 % **Z** = jumper	**K** = ± 100 ppm/K **N** = ± 200 ppm/K **S** = jumper	**EA, ED**	**SR** = standard sulfur resistant

Product Description: RCA0603-SR 100 1K0 1 % ET1 e3
Product Description: RCA0603-SR 0R0 ET1 e3

RCA0603-SR	100	1K0	1 %	ET1	e3
TYPE / SIZE	TCR	RESISTANCE	TOLERANCE	PACKAGING	LEAD (Pb)-FREE
RCA0201-SR **RCA0402-SR** **RCA0603-SR** **RCA0805-SR** **RCA1206-SR**	± **100** ppm/K ± **200** ppm/K	**10R** = 10 Ω **1K** = 1 kΩ **1M** = 1 MΩ **0R0** = jumper	± **1 %** ± **5 %**	**ET1, ET7**	**e3** = pure tin termination finish

DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A special cermet film layer and a glass-over are deposited on a high grade (Al_2O_3) ceramic substrate. 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. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure matte tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure on 100 % of the individual chip resistors. Only accepted products are laid directly into the tape in accordance with **IEC 60286-3 Type 1a** (1).

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapor phase as shown in **IEC 61760-1** (1). The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, potting compounds and their processes, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

The resistors are RoHS-compliant, the pure matte tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. Solderability is specified for 2 years after production or requalification. The permitted storage time is 20 years. The immunity of the plating against tin whisker growth has been proven under extensive testing.

MATERIALS

Vishay acknowledges the following systems for the regulation of hazardous substances:

- IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein (2)
- The Global Automotive Declarable Substance List (GADSL) (3)
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) (4) for its supply chain

The products do not contain any of the banned substances as per IEC 62474, GADSL, or the SVHC list, see www.vishay.com/how/leadfree.

Hence the products fully comply with the following directives:

- 2000/53/EC End-of-Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the Use of Hazardous Substances Directive (RoHS) with amendment 2015/863/EU
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

Vishay pursues the elimination of conflict minerals from its supply chain, see the Conflict Minerals Policy at www.vishay.com/doc?49037.

APPROVALS

The resistors are qualified according to AEC-Q200.

Where applicable, the resistors are tested in accordance with **EN 140401-802** which refers to **EN 60115-1**, **EN 60115-8** and the variety of environmental test procedures of the **IEC 60068** (1) series.

RELATED PRODUCTS

For more information about products with superior sulfur resistance please refer to RCA e3 datasheet (www.vishay.com/doc?20037).

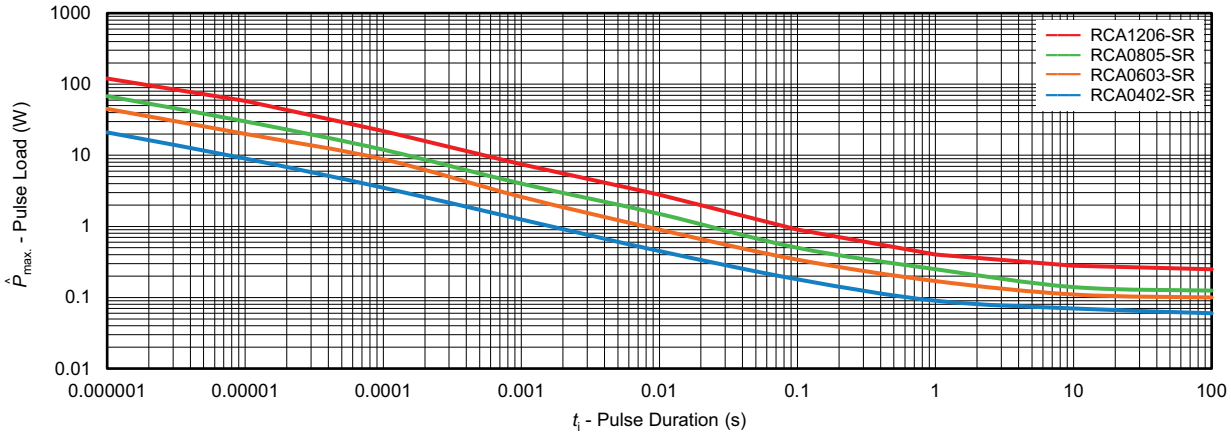
Notes

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents
(2) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at http://std.iec.ch/iec62474
(3) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at www.gadsl.org
(4) The SVHC list is maintained by the European Chemical Agency (ECHA) and available at http://echa.europa.eu/candidate-list-table

FUNCTIONAL PERFORMANCE

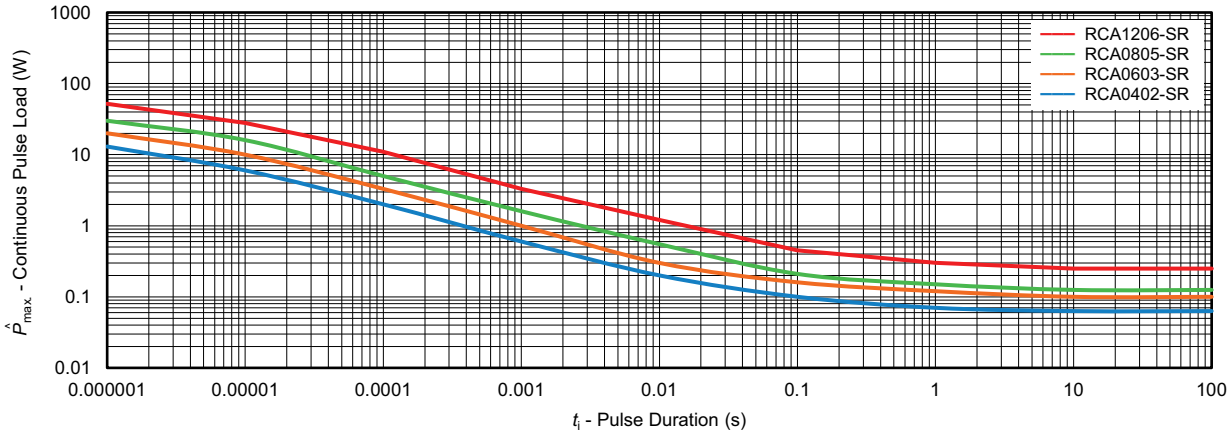
PERFORMANCE IN SULFUR-CONTAINING AMBIANCE	
TEST NAME	**HUMID SULFUR VAPOR TEST**
Reference specification	ASTM B809-95
Test conditions (temperature, humidity)	60 °C ± 2 °C 85 % ± 4 % RH
Aggressive agent	Sulfur (saturated vapor)
Failure criteria in VI under magnification	No silver sulfide growth at the interface between termination and protective overcoat No signs of mechanical damage
Failure criteria in electrical test	≤ (± 1 % R + 0.05 Ω)
Test duration	1000 h

Single Pulse



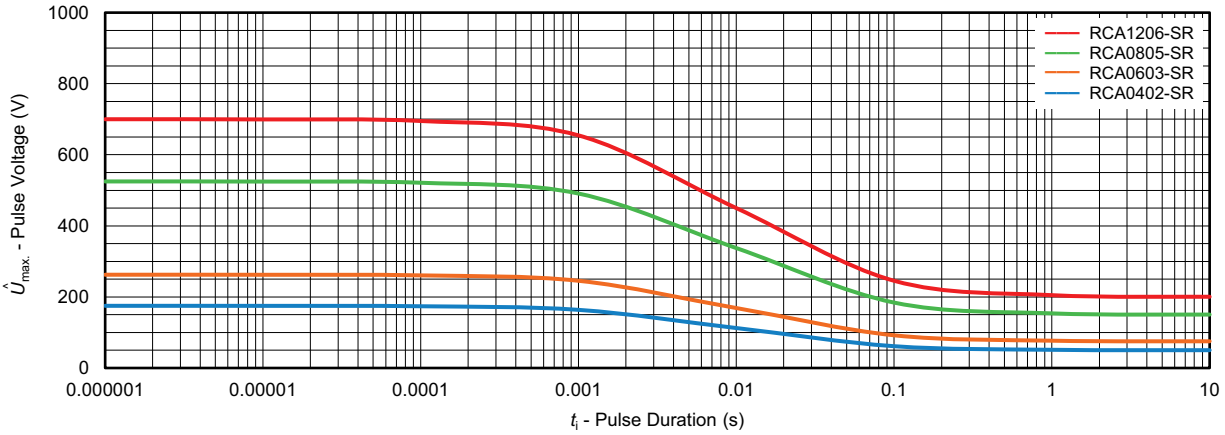
Maximum pulse load, single pulse; applicable if $\overline{P} \rightarrow 0$ and n < 1000 and $\hat{U} = \hat{U}_{max.}$; standard operation mode, for permissible resistance change ± (2 % R + 0.1 Ω)

Continuous Pulse



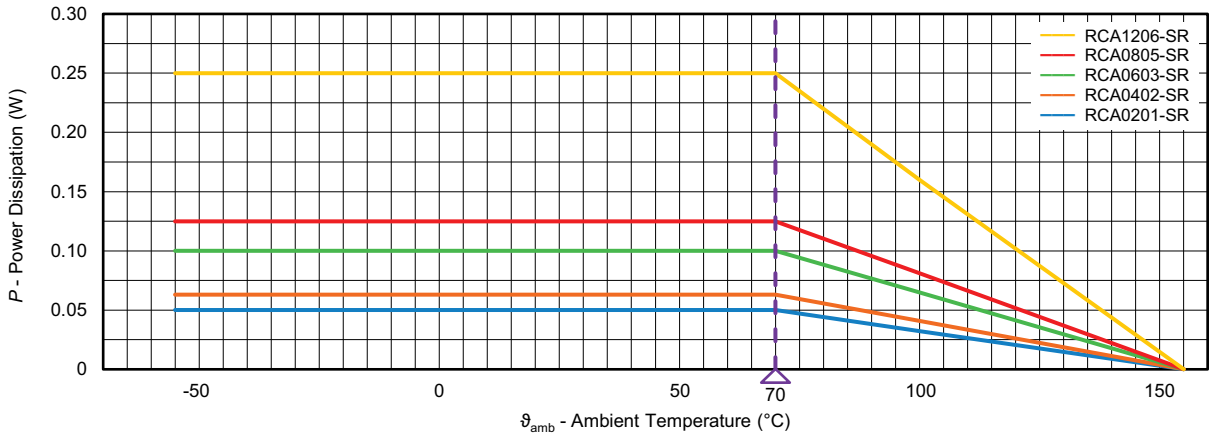
Maximum pulse load, continuous pulses; applicable if $\overline{P} \leq P(\vartheta_{amb})$ and $\hat{U} = \hat{U}_{max.}$; standard operation mode, for permissible resistance change ± (2 % R + 0.1 Ω)

Pulse Voltage

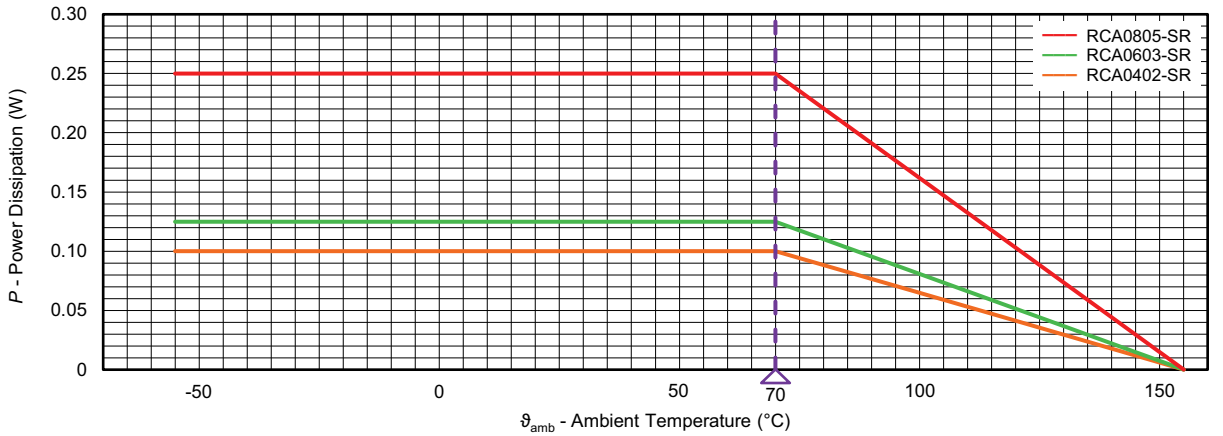


Maximum pulse voltage, single and continuous pulses; applicable if $\hat{P} = \hat{P}_{max.}$; standard operation mode, for permissible resistance change ± (2 % R + 0.1 Ω)

Derating



Derating - Extended Operation



TESTS AND REQUIREMENTS

All executed tests are carried out in accordance with the following specifications:

EN 60115-1, generic specification

EN 60115-8 (successor of EN 140400), sectional specification

EN 140401-802, detail specification

IEC 60068-2-xx, test methods

The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-802. The table presents only the most important tests, for the full test schedule refer to the documents listed above. However, some additional tests and a number of improvements against those minimum requirements have been included.

The testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5201-1.

The tests are carried out under standard atmospheric conditions in accordance with IEC 60068-1, 4.3, whereupon the following values are applied:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

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

A climatic category LCT / UCT / 56 is applied, defined by the lower category temperature (LCT), the upper category temperature (UCT), and the duration of exposure in the damp heat, steady state test (56 days). The components are mounted for testing on boards in accordance with EN 60115-8, 2.4.2 unless otherwise specified.

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 [1] TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR) [1]			
			Stability for product types:	STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER	STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER
			RCA-SR e3	RCA0201-SR e3		RCA0402-SR e3 TO RCA1206-SR e3	
				10 Ω to 1 MΩ		10 Ω to 10 MΩ	
6.1	-	Measurements of resistance and tolerance	-	± 1 %	± 5 %	± 1 %	± 5 %
6.2	-	Temperature coefficient of resistance	At (20 / -55 / 20) °C and (20 / 155 / 20) °C	± 200 ppm/K		± 100 ppm/K	± 200 ppm/K
7.1	-	Endurance at rated temperature 70 °C	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1.5 h on; 0.5 h off 70 °C; 1000 h	± (2 % R + 0.1 Ω)		± (1 % R + 0.05 Ω)	± (2 % R + 0.1 Ω)
		Endurance at rated temperature 70 °C Extended operation mode		-		± (2 % R + 0.1 Ω)	
7.3	-	Endurance at maximum temperature	155 °C, 1000 h	± (2 % R + 0.1 Ω)		± (1 % R + 0.05 Ω)	± (2 % R + 0.1 Ω)
10.4	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; (93 ± 3) % RH; 56 days	± (2 % R + 0.1 Ω)		± (1 % R + 0.05 Ω)	
10.5	67 (Cy)	Damp heat, steady state, accelerated Extended or standard operation mode depend on case size	(85 ± 2) °C; (85 ± 5) % RH; $U = \sqrt{0.1 \times P_{85} \times R} \leq 100$ V; 1000 h	± (2 % R + 0.1 Ω)		± (1 % R + 0.05 Ω)	± (2 % R + 0.1 Ω)
10.1	14 (Na)	Rapid change of temperature	30 min at -55 °C; and 30 min at 125 °C; 1000 cycles	± (1 % R + 0.05 Ω) no visible damage			
8.1	-	Short-term overload	$U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$; whichever is the less severe; 5 s	± (2 % R + 0.05 Ω)			
8.4	-	Periodic electric overload	$U = \sqrt{15 \times P_{70} \times R}$ or $\leq 2 \times U_{max.}$; whichever is the less severe; 0.1 s on; 2.5 s off; 1000 cycles	± (1 % R + 0.05 Ω) no visible damage			
		Periodic electric overload Extended operation mode		-		± (2 % R + 0.1 Ω) no visible damage	

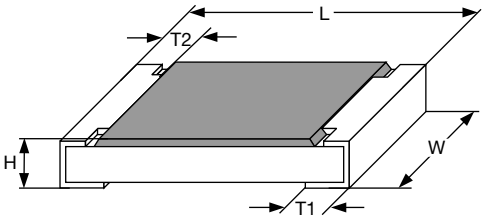
TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 [1] TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR) [1]			
			Stability for product types:	STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER	STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER
			RCA-SR e3	RCA0201-SR e3		RCA0402-SR e3 TO RCA1206-SR e3	
				10 Ω to 1 MΩ		10 Ω to 10 MΩ	
8.5	-	Electrostatic discharge (human body model)	IEC 61340-3-1 [1]; 3 pos. + 3 neg. discharges; ESD voltage acc. to the size: RCA0201-SR e3: 250 V RCA0402-SR e3: 400 V RCA0603-SR e3: 800 V RCA0805-SR e3: 1000 V RCA1206-SR e3: 2000 V	± (2 % R + 0.1 Ω)		± (1 % R + 0.05 Ω)	
9.11	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 2000 Hz; no resonance; amplitude ≤ 1.5 mm or ≤ 200 m/s^2; 7.5 h	± (0.25 % R + 0.05 Ω) no visible damage	± (0.5 % R + 0.05 Ω) no visible damage	± (0.25 % R + 0.05 Ω) no visible damage	± (0.5 % R + 0.05 Ω) no visible damage
11.1	58 (Td)	Solderability	Solder bath method; Sn60Pb40 non-activated flux; (235 ± 5) °C (2 ± 0.2) s	Good tinning (≥ 95 % covered); no visible damage			
			Solder bath method; Sn99.3Cu0.7 non-activated flux; (245 ± 5) °C; (3 ± 0.3) s				
11.2	58 (Td)	Resistance to soldering heat	Solder bath method (260 ± 5) °C; (10 ± 1) s	± (0.5 % R + 0.05 Ω)			
11.3	45 (XA)	Component solvent resistance	Isopropyl alcohol; 50 °C; method 2	No visible damage			
9.7	21 (Ue_3)	Shear (adhesion)	RCA0201-SR: 2N RCA0402-SR and RCA0603-SR: 9 N RCA0805-SR and RCA1206-SR: 17.7 N	No visible damage			
9.8	21 (Uu_1)	Substrate bending	Depth 2 mm; 3 times	± (0.5 % R + 0.05 Ω) no visible damage, no open circuit in bent position			
12.2	-	Voltage proof	U = 1.4 x U_{ins}; 60 s	No flashover or breakdown			
12.4	-	Flammability, needle flame test	IEC 60695-11-5 [1]; 10 s	No burning after 30 s			

Note

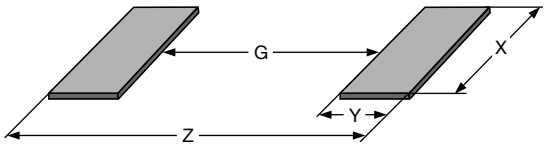
[1] The quoted IEC standards are also released as EN standards with the same number and identical contents

DIMENSIONS



DIMENSIONS AND MASS						
TYPE / SIZE	L (mm)	W (mm)	H (mm)	T1 (mm)	T2 (mm)	MASS (mg)
RCA0201-SR e3	0.6 ± 0.03	0.3 ± 0.03	0.23 ± 0.03	0.15 ± 0.05	0.1 ± 0.05	0.17
RCA0402-SR e3	1.0 ± 0.05	0.5 ± 0.05	0.35 ± 0.05	0.25 ± 0.10	0.2 ± 0.10	0.65
RCA0603-SR e3	1.55 + 0.10 / - 0.05	0.85 ± 0.10	0.45 ± 0.05	0.3 ± 0.20	0.3 ± 0.20	2
RCA0805-SR e3	2.0 + 0.20 / - 0.10	1.25 ± 0.15	0.5 ± 0.10	0.3 + 0.20 / - 0.10	0.3 ± 0.20	5.5
RCA1206-SR e3	3.2 + 0.10 / - 0.20	1.6 ± 0.15	0.55 ± 0.05	0.45 ± 0.20	0.4 ± 0.20	10

SOLDER PAD DIMENSIONS



RECOMMENDED SOLDER PAD DIMENSIONS								
TYPE / SIZE	WAVE SOLDERING				REFLOW SOLDERING			
	G (mm)	Y (mm)	X (mm)	Z (mm)	G (mm)	Y (mm)	X (mm)	Z (mm)
RCA0201-SR e3	-	-	-	-	0.23	0.28	0.43	0.79
RCA0402-SR e3	-	-	-	-	0.45	0.60	0.60	1.65
RCA0603-SR e3	0.65	1.10	1.25	2.85	0.75	0.75	1.00	2.25
RCA0805-SR e3	0.90	1.30	1.60	3.50	1.00	0.95	1.45	2.90
RCA1206-SR e3	1.40	1.40	1.95	4.20	1.50	1.05	1.80	3.60

Notes

- The given solder pad dimensions reflect the considerations for board design and assembly as outlined e.g in standards IEC 61188-5-x [(1)] or in publication IPC-7351.
  Still, the given solder pad dimensions will be found adequate for most general applications

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents

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