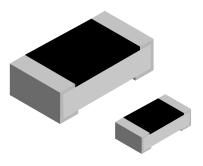
RCS e3

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Vishav

Anti-Surge, High Power Thick Film Chip Resistors



The anti-surge thick film chip resistor series combines a significantly higher power rating and pulse load performance as compared to standard chip resistors.

FEATURES

- Excellent surge pulse capability
- Superior ESD surge characteristics
- High power rating
- AEC-Q200 qualified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Automotive
- Industrial
- Telecommunications
- Medical

TECHNICAL SPECIFICATIONS					
DESCRIPTION	RCS0402 e3	RCS0603 e3	RCS0805 e3	RCS1206 e3	
Imperial size	0402	0603	0805	1206	
Metric size code	RR1005M	RR1608M	RR2012M	RR3126M	
Resistance range	1 Ω to 10 MΩ; jumper (0 Ω)				
Resistance tolerance	± 5 %; ± 1 %; ± 0.5 %				
Temperature coefficient	± 200 ppm/K; ± 100 ppm/K				
Rated dissipation, P ₇₀ ⁽¹⁾	0.2 W	0.25 W	0.4 W	0.5 W	
Operating voltage, U _{max.} AC _{RMS} /DC	50 V	75 V	150 V	200 V	
Permissible film temperature, $\mathcal{P}_{F max.}$ ⁽¹⁾		155	5 °C		
Operating temperature range	-55 °C to +155 °C				
Max. resistance change at P_{70} for resistance range, $ \Delta R/R $ after:					
1000 h		≤ 1.	0 %		
8000 h		≤2.	0 %		
Permissible voltage against ambient (insulation):					
1 min, U _{ins}	75 V	100 V	200 V	300 V	

Note

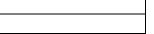
⁽¹⁾ Please refer to APPLICATION INFORMATION below

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.

Revision:	07-Mar-2019
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TEMPERATURE COEFFICIENT AND RESISTANCE RANGE						
TYPE / SIZE	TCR	TOLERANCE	RESISTANCE	E-SERIES		
	± 200 ppm/K	±5%	1 Ω to 10 M Ω	E24		
RCS0402 e3	± 100 ppm/K	±1%	1 Ω to 10 M Ω	E24; E96		
n030402 e3	± 100 ppm/K	± 0.5 %	1 Ω to 10 MΩ	E24; E96		
	Jumper, I _{max.} = 3 A	\leq 20 m Ω	0 Ω	-		
	± 200 ppm/K	±5%	1 Ω to 10 MΩ	E24		
RCS0603 e3	± 100 ppm/K	±1%	1 Ω to 10 MΩ	E24; E96		
nc30003 e3	± 100 ppm/K	± 0.5 %	1 Ω to 10 M Ω	E24; E96		
	Jumper, I _{max.} = 3.5 A	\leq 20 m Ω	0 Ω	-		
	± 200 ppm/K	±5%	1 Ω to 10 M Ω	E24		
RCS0805 e3	± 100 ppm/K	±1%	1 Ω to 10 MΩ	E24; E96		
RC30005 e3	± 100 ppm/K	± 0.5 %	1 Ω to 10 MΩ	E24; E96		
	Jumper, I _{max.} = 4 A	\leq 20 m Ω	0 Ω	-		
	± 200 ppm/K	±5%	1 Ω to 10 M Ω	E24		
RCS1206 e3	± 100 ppm/K	±1%	1 Ω to 10 M Ω	E24; E96		
	± 100 ppm/K	± 0.5 %	1 Ω to 10 $M\Omega$	E24; E96		
	Jumper, I _{max.} = 5 A	\leq 20 m Ω	0 Ω	-		

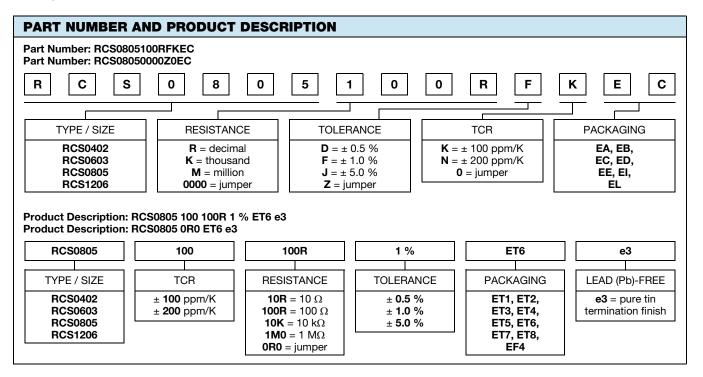
Note

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

PACKAGING						
TYPE / SIZE	CODE	QUANTITY	TITY PACKAGING STYLE		РІТСН	PACKAGING DIMENSIONS
RCS0402 e3	ED = ET7	10 000			2 mm	Ø 180 mm/7"
nc 30402 e3	EE = EF4	50 000			2 11111	Ø 330 mm/13"
	EI = ET2	5000				Ø 180 mm/7"
	ED = ET3	10 000			2 mm 4 mm	Ø 180 mm/7"
	EL = ET4	20 000	Paper tape according to IEC 60286-3, Type 1a			Ø 285 mm/11.25"
RCS0603 e3	EE = ET8	50 000				Ø 330 mm/13"
	EA = ET1	5000				Ø 180 mm/7"
	EB = ET5	10 000		8 mm		Ø 285 mm/11.25"
	EC = ET6	20 000				Ø 330 mm/13"
	EA = ET1	5000				Ø 180 mm/7"
RCS0805 e3	EB = ET5	10 000			4 mm	Ø 285 mm/11.25"
	EC = ET6	20 000				Ø 330 mm/13"
	EA = ET1	5000			4 mm	Ø 180 mm/7"
RCS1206 e3	EB = ET5	10 000				Ø 285 mm/11.25"
	EC = ET6	20 000				Ø 330 mm/13"

2





RCS e3





DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A cermet film layer and a glass-over are deposited on a high grade (AI_2O_3) ceramic substrate with its prepared inner contacts on both sides. A special laser is used to achieve the target value and the desired power dissipation performance 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 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**. 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 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 <u>www.vishay.com/how/leadfree</u>.

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 surge and pulse performance please refer to D/CRCW-IF e3, Pulse Proof Thick Film Chip Resistors datasheet (www.vishay.com/doc?20024).

The CRCW-HP e3 product series is designed for those applications where both enhanced power rating and superior pulse loading performance is required.

For ordering CRCW-HP e3 please refer to latest edition of datasheet (<u>www.vishay.com/doc?20043</u>).

For thick film resistors with standard requirements for power rating, please refer to D/CRCW e3, Standard Thick Film Chip Resistors datasheet (<u>www.vishay.com/doc?20035</u>)

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 <u>www.gadsl.org</u>
- ⁽⁴⁾ The SVHC list is maintained by the European Chemical Agency (ECHA) and available at <u>http://echa.europa.eu/candidate-list-table</u>

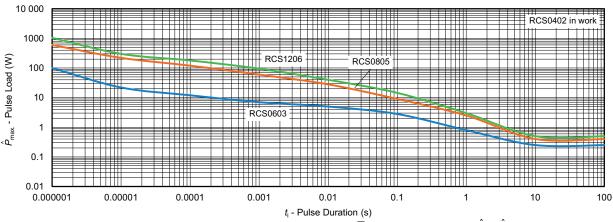
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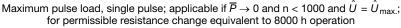
For technical questions, contact: <u>thickfilmchip@vishay.com</u> THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT <u>www.vishay.com/doc?91000</u>



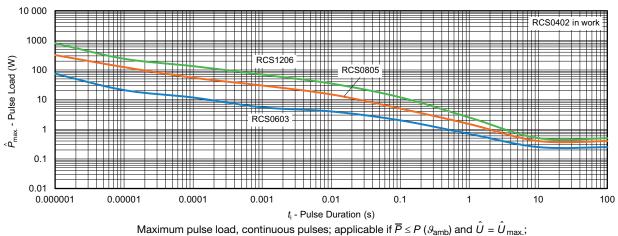
FUNCTIONAL PERFORMANCE

Single Pulse



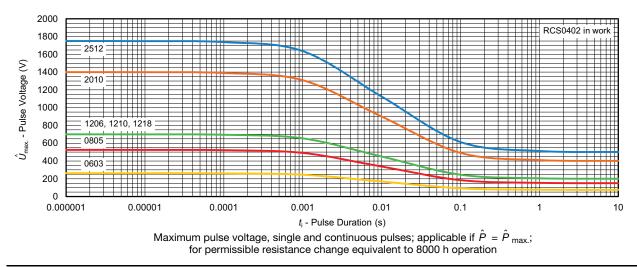


Continuous Pulse



for permissible resistance change equivalent to 8000 h operation

Pulse Voltage

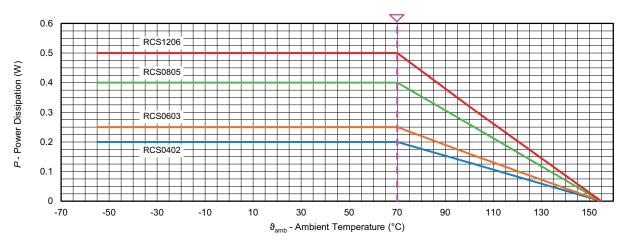


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TESTS AND REQUIREMENTS

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							
60115-1 TEST	IEC		PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (∆R)			
	60082-2 ⁽¹⁾ TEST	TEST	PROCEDORE	STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER		
CLAUSE	METHOD	ETHOD	Stability for product types:	1.0 to	10 MO		
			RCS e3	1 Ω to 10 MΩ			
4.5	-	Resistance	-	± 0.5 %; ± 1 %	± 5 %		
4.8	-	Temperature coefficient	At (20 / -55 / 20) °C and (20 / 155 / 20) °C	± 100 ppm/K	± 200 ppm/K		
4.25.1	-	Endurance at 70 °C	$U = \sqrt{P_{70} \times R} \text{ or } U = U_{\text{max.}}$ whichever is the less severe; 1.5 h on; 0.5 h off 70 °C; 1000 h 70 °C; 8000 h	± (1 % <i>R</i> + 0.05 Ω) ± (2 % <i>R</i> + 0.1 Ω)	± (2 % <i>R</i> + 0.1 Ω) ± (4 % <i>R</i> + 0.1 Ω)		
4.25.3	-	Endurance at upper category temperature	155 °C; 1000 h	± (1 % <i>R</i> + 0.05 Ω)	± (2 % <i>R</i> + 0.1 Ω)		
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (1 % <i>R</i> + 0.05 Ω)			



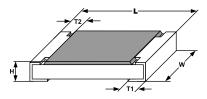
	IEC			REQUIREMENTS PERMISSIBLE CHANGE (∆R)		
EN 60115-1	IEC 60082-2 ⁽¹⁾ TEST	TEST	PROCEDURE	STABILITY CLASS 1 OR BETTER		
CLAUSE	METHOD		Stability for product types:	1 Ω to 10 MΩ		
		Damp heat, steady state,	RCS e3 (85 ± 2) °C; (85 ± 5) % RH			
4.37	67 (Cy)	accelerated	$U = \sqrt{0.1 \times P_{85} \times R} \le 100 \text{ V};$ 1000 h	± (1 % <i>R</i> + 0.05 Ω)	± (2 % <i>R</i> + 0.1 Ω)	
4.23	-	Climatic sequence:				
4.23.2	2 (Bb)	Dry heat	125 °C; 16 h			
4.23.3	30 (Db)	Damp	55 °C; 24 h; ≥ 90 % RH; 1 cycle			
4.23.4	1 (Ab)	Cold	-55 °C; 2 h			
4.23.5	13 (M)	Low air pressure	8.5 kPa; 2 h; (25 ± 10) °C	± (1 % <i>R</i> + 0.05 Ω)	± (2 % <i>R</i> + 0.1 Ω)	
			55 °C; 24 h;			
4.23.6	30 (Db)	Damp heat, cyclic	≥ 90 % RH; 5 cycles			
4.23.7	-	DC load	$U = \sqrt{P_{70} \times R} \le U_{\text{max.}}$; 1 min			
-	1 (Aa)	Cold	-55 °C; 2 h	± (0.25 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω	
	. ,	D	30 min. at -55 °C and			
4.19	14 (Na)	Rapid change	30 min. at 125 °C	± (1 % R		
	. ,	of temperature	1000 cycles	no visible	amage	
4.13	-	Short time overload	$U = 2.5 \text{ x } \sqrt{P_{70} \text{ x } R} \le 2 \text{ x } U_{\text{max.}};$ whichever is the less severe; 5 s	± (2 % R	+ 0.05 Ω)	
			Severity no. 4:			
			$U = 10 \text{ x} \sqrt{P_{TO} \text{ x} R}$			
4.27	-	Single pulse	$U = 10 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.;}$	± (1 % <i>R</i> + 0.05 Ω) no visible damage		
		high voltage overload	whichever is the less severe;			
			10 pulses 10 µs / 700 µs			
			$U = \sqrt{15 \times P_{70} \times R}$ or $U = 2 \times U_{max.;}$			
			$U = 2 \times U_{\text{max.}}$	\pm (1 % R + 0.05 Ω) no visible damage		
4.39	-	Periodic electric overload	whichever is the less severe;			
			0.1 s on; 2.5 s off; 1000 cycles			
			IEC 61340-3-1 ⁽¹⁾ ;			
4.38	_	Electrostatic discharge	3 positive + 3 negative discharges;	± (1 % R	+ 0.05 (0)	
4.00	_	(human body model)	ESD voltage according to the size	±(1 /0 /1	+ 0.03 32)	
			Endurance by sweeping;			
			10 Hz to 2000 Hz;	/		
4.22	6 (Fc)	Vibration	no resonance;	$\pm (0.25 \% R + 0.05 \Omega)$	± (0.5 % <i>R</i> + 0.05 Ω) no visible damage	
	. ,		amplitude \leq 1.5 mm or \leq 200 m/s ² ;	no visible damage		
			7.5 h			
			Solder bath method,			
			SnPb40; non-activated flux			
			(235 ± 5) °C; (2 ± 0.2) s	Good tinning (≥	95 % covered):	
4.17	58 (Td)	Solderability	Solder bath method,	no visible		
			Sn96.5Ag3Cu0.5;			
			non-activated flux (245 \pm 5) °C; (3 \pm 0.3) s			
		Resistance to	Soldering bath method;			
4.18	58 (Td)	soldering heat	(260 ± 5) °C; (10 ± 1) s	\pm (0.25 % R + 0.05 Ω)	± (0.5 % <i>R</i> + 0.05 Ω	
4.29	45 (XA)	Component solvent	Isopropyl alcohol +50 °C;	No visible damage		
		resistance Shear	method 2 RCS0402 e3: 9 N			
4.32	21 (Ue ₃)	(adhesion)	RCS0603 e3 and RCS0805 e3: 17.7 N			
			_	± (0.25 % /	,	
4.33	21 (Ue ₁)	Substrate bending	Depth 2 mm; 3 times	no visible		
				no open circuit		
4.7	-	Voltage proof	$U = 1.4 \times U_{\text{ins}}; 60 \text{ s}$	No flashover	or breakdown	
4.35	_	Flammability,	IEC 60695-11-5 ⁽¹⁾ ;	No burning	g after 30 s	
		needle flame test	10 s	10 24.1119	,	

Note

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

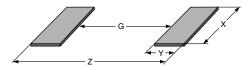


DIMENSIONS



DIMENSIONS AND MASS									
TYPE / SIZE	L (mm)	W (mm)	H (mm)	T1 (mm)	T2 (mm)	MASS (mg)			
RCS0402 e3	1.0 ± 0.05	0.5 ± 0.05	0.35 ± 0.05	0.25 ± 0.05	0.2 ± 0.10	0.65			
RCS0603 e3	1.55 + 0.10 / - 0.05	0.85 ± 0.10	0.45 ± 0.05	0.3 ± 0.20	0.3 ± 0.20	2			
RCS0805 e3	2.0 + 0.20 / - 0.10	1.25 ± 0.15	0.45 ± 0.05	0.3 + 0.20 / - 0.10	0.3 ± 0.20	5.5			
RCS1206 e3	3.2 + 0.10 / - 0.20	1.6 ± 0.15	0.55 ± 0.10	0.45 ± 0.20	0.4 ± 0.20	10			

SOLDER PAD DIMENSIONS



RECOMMENDED SOLDER PAD DIMENSIONS								
	WAVE SOLDERING			REFLOW SOLDERING				
TYPE / SIZE	G (mm)	Y (mm)	X (mm)	Z (mm)	G (mm)	Y (mm)	X (mm)	Z (mm)
RCS0402 e3	-	-	-	-	0.45	0.6	0.6	1.65
RCS0603 e3	0.65	1.10	1.25	2.85	0.75	0.75	1.00	2.15
RCS0805 e3	0.90	1.30	1.60	3.50	1.00	0.95	1.45	2.90
RCS1206 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

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



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