

## High Voltage (Up to 2 kV) Thick Film Chip Resistors



The RCV e3 high voltage thick film chip resistors series are the perfect choice for modern electronics with high voltage requirements. Typical applications include E-meter, AC power supplies, lighting ballasts and inverters for industrial drives, aircons, and white good.

### FEATURES

- High operating voltage (up to 2 kV)
- Low voltage coefficient of resistance (VCR): 25 ppm/V
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### APPLICATIONS

- E-meter
- Inverters for industrial drives, aircons, and white good
- AC power supplies
- Lighting ballasts

TECHNICAL SPECIFICATIONS			
DESCRIPTION	RCV0805 e3	RCV1206 e3	RCV2010 e3
Imperial size	0805	1206	2010
Metric size code	RR2012M	RR3216M	RR5025M
Resistance range	100 kΩ to 10 MΩ		
Resistance tolerance	± 5 %; ± 1 %		
Temperature coefficient	± 200 ppm/K; ± 100 ppm/K		
Voltage coefficient Icl of resistance chart	25 ppm/V		
Rated dissipation, $P_{70}$ <sup>(1)</sup>	0.125 W	0.25 W	0.75 W
Operating voltage, $U_{max}$ . AC <sub>RMS</sub> /DC	400 V	500 V	2000 V
Permissible film temperature, $\vartheta_{F max}$ . <sup>(1)</sup>	155 °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 %	≤ 1.0 %	≤ 2.0 %

#### Notes

- Application-specific safety requirements may set limitations to the applicability of the specified voltage
- <sup>(1)</sup> 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.



TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
TYPE / SIZE	TCR	TOLERANCE	RESISTANCE	E-SERIES
RCV0805 e3	± 200 ppm/K	± 5 %	100 kΩ to 10 MΩ	E24
	± 100 ppm/K	± 1 %	100 kΩ to 10 MΩ	E24; E96
RCV1206 e3	± 200 ppm/K	± 5 %	100 kΩ to 10 MΩ	E24
	± 100 ppm/K	± 1 %	100 kΩ to 10 MΩ	E24; E96
RCV2010 e3	± 200 ppm/K	± 5 %	100 kΩ to 10 MΩ	E24
	± 100 ppm/K	± 1 %	100 kΩ to 10 MΩ	E24; E96

PACKAGING						
TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS
RCV0805 e3	EA = ET1	5000	Paper tape according to IEC 60286-3, type 1a	8 mm	4 mm	Ø 180 mm / 7"
	EB = ET5	10 000				Ø 285 mm / 11.25"
	EC = ET6	20 000				Ø 330 mm / 13"
RCV1206 e3	EA = ET1	5000				Ø 180 mm / 7"
	EB = ET5	10 000				Ø 285 mm / 11.25"
	EC = ET6	20 000				Ø 330 mm / 13"
RCV2010 e3	EF = E02	4000	Blister tape according to IEC 60286-3, type 2a	12 mm	4 mm	Ø 180 mm / 7"

**PART NUMBER AND PRODUCT DESCRIPTION**

Part Number: RCV1206100KFKEA

R	C	V	1	2	0	6	1	0	0	K	F	K	E	A
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TYPE / SIZE RCV0805 RCV1206 RCV2010	RESISTANCE K = thousand M = million	TOLERANCE F = ± 1 % J = ± 5 %	TCR K = ± 100 ppm/K N = ± 200 ppm/K	PACKAGING EA, EB, EC, EF
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Product Description: RCV1206 100 100K 1 % ET1 e3

RCV1206	100	100K	1 %	ET1	e3
TYPE / SIZE RCV0805 RCV1206 RCV2010	TCR ± 100 ppm/K ± 200 ppm/K	RESISTANCE 100K = 100 kΩ 1M = 1 MΩ 10M = 10 MΩ 100M = 100 MΩ	TOLERANCE ± 1 % ± 5 %	PACKAGING ET1, ET5, ET6, E02	LEAD (Pb)-FREE e3 = pure tin termination finish



## 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 (Al<sub>2</sub>O<sub>3</sub>) 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 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 and 2a** <sup>(1)</sup>.

## 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** <sup>(1)</sup>. 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 <sup>(2)</sup>
- The Global Automotive Declarable Substance List (GADSL) <sup>(3)</sup>
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) <sup>(4)</sup> 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](http://www.vishay.com/how/leadfree).

## Notes

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

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](http://www.vishay.com/doc?49037).

## APPROVALS

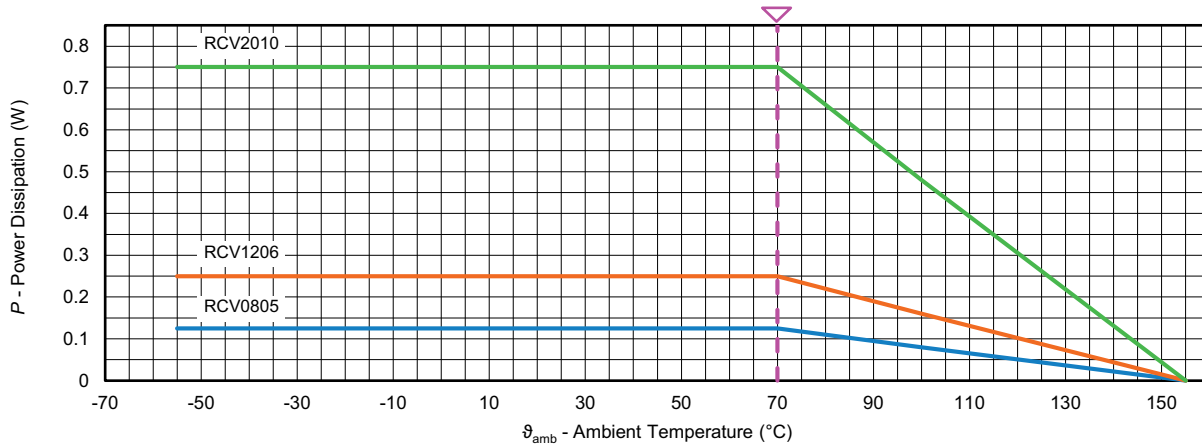
Where applicable, the resistors are tested in accordance with **EN 140401-802** which refers to **EN 60115-1**, **EN 60115-8** and the variety of environmental test procedures of the **IEC 60068** <sup>(1)</sup> series.

## RELATED PRODUCTS

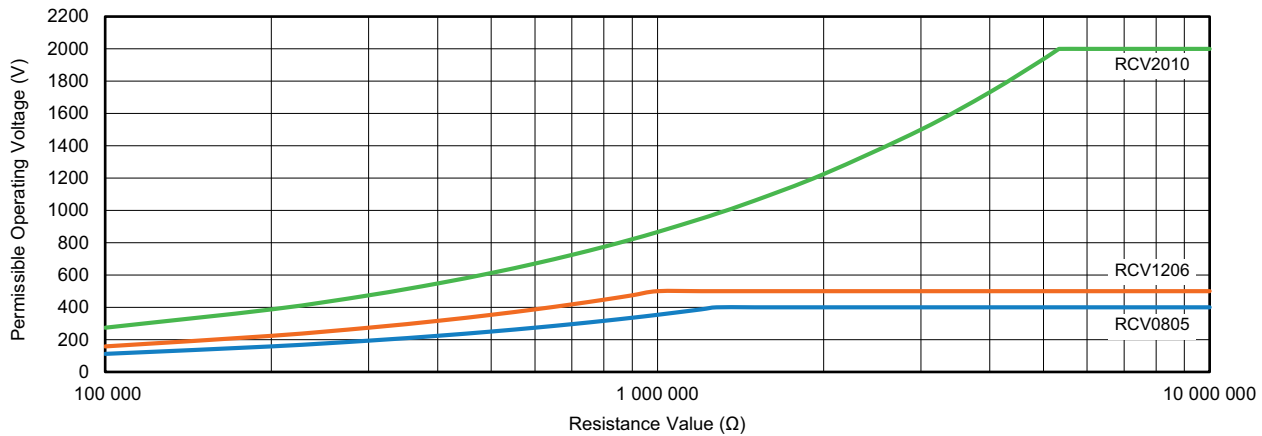
For high voltage thin film products, please refer to latest edition of TNPV e3, High Voltage Thin Film Chip Resistors datasheet, [www.vishay.com/doc?28881](http://www.vishay.com/doc?28881).

For products with professional specification, please refer to latest edition of MMA0204 HV, MMB0207 HV, Professional High Voltage Thin Film MELF Resistors datasheet, [www.vishay.com/doc?28880](http://www.vishay.com/doc?28880).

**DERATING**



**NOMINAL OPERATING VOLTAGE**



The permissible operating voltage  $U_{max}$  equals the rated voltage.  
 For ambient temperatures above 70 °C power derating must be considered

**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).

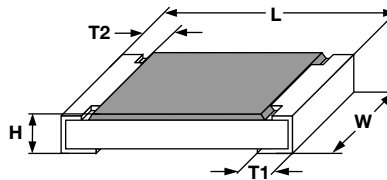


TEST PROCEDURES AND REQUIREMENTS							
EN 60115-1 CLAUSE	IEC 60082-2 (1) TEST METHOD	TEST	PROCEDURE			REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R$ )	
						STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER
			Stability for product types: <b>RCV e3</b>			100 k $\Omega$ to 10 M $\Omega$	
4.5	-	Resistance	-			$\pm 1 \%$	$\pm 5 \%$
4.8	-	Temperature coefficient	At (20 / -55 / 20) °C and (20 / 155 / 20) °C			$\pm 100$ ppm/K	$\pm 200$ ppm/K
4.25.1	-	Endurance at 70 °C	$U = P_{70} \times R$ or $U = U_{max.}$ whichever is the less severe; 1.5 h on; 0.5 h off 70 °C; 1000 h			RCV0805, RCV1206: $\pm (1 \% R + 0.05 \Omega)$ RCV2010: $\pm (2 \% R + 0.1 \Omega)$	
4.25.3	-	Endurance at upper category temperature	155 °C; 1000 h			$\pm (2 \% R + 0.1 \Omega)$	
4.24	78 (Cab)	Damp heat, steady state	(40 $\pm$ 2) °C; 56 days; (93 $\pm$ 3) % RH			$\pm (1 \% R + 0.05 \Omega)$	$\pm (2 \% R + 0.1 \Omega)$
4.23	-	Climatic sequence:	125 °C; 16 h			$\pm (1 \% R + 0.05 \Omega)$	$\pm (2 \% R + 0.1 \Omega)$
4.23.2	2 (Bb)	Dry heat	55 °C; 24 h; $\geq 90$ % RH; 1 cycle				
4.23.3	30 (Db)	Damp heat, cyclic	-55 °C; 2 h				
4.23.4	1 (Ab)	Cold	8.5 kPa; 2 h; (25 $\pm$ 10) °C				
4.23.5	13 (M)	Low air pressure	55 °C; 5 days; $> 90$ % RH; 5 cycles				
4.23.6	30 (Db)	Damp heat, cyclic	$U = (P_{70} \times R)^{1/2} \leq U_{max.}$ ; 1 min			$\pm (0.5 \% R + 0.05 \Omega)$	
4.23.7	-	DC load	-55 °C; 2 h				
-	1 (Aa)	Cold					
4.19	14 (Na)	Rapid change of temperature	30 min. at -55 °C and 30 min. at 125 °C; RCV 0805 RCV1206: 1000 cycles RCV2010: 100 cycles			$\pm (1 \% R + 0.05 \Omega)$ no visible damage	
4.13	-	Short time overload	$U = 2.5 \times (P_{70} \times R)^{1/2} \leq 2 \times U_{max.}$ ; whichever is the less severe; 5 s			RCV0805, RCV1206: $\pm (0.25 \% R + 0.05 \Omega)$ RCV2010: $\pm (2.0 \% R + 0.05 \Omega)$	
			Style	Duration	Maximum $U_{OL}$		
			RCV0805	1 s	800		
			RCV1206	2 s	1000		
RCV2010	5 s	3000					
4.27	-	Single pulse high voltage overload 10 $\mu$ s / 700 $\mu$ s	Severity no. 4: $U = 10 \times (P_{70} \times R)^{1/2}$ or $U = 2 \times U_{max.}$ ; whichever is the less severe; 10 pulses			$\pm (2 \% R + 0.1 \Omega)$ no visible damage	
4.39	-	Periodic electric overload	$U = 15 \times P_{70} \times R$ or $U = 2 \times U_{max.}$ ; whichever is the less severe; 0.1 s on; 2.5 s off; 1000 cycles			$\pm (2 \% R + 0.05 \Omega)$ no visible damage	
4.38	-	Electrostatic discharge (human body model)	IEC 61340-3-1 (1); 3 positive + 3 negative discharges; RCV0805: 1000 V RCV1206: 2000 V RCV2010: 12 000 V			$\pm (1 \% R + 0.05 \Omega)$	
4.22	6 (Fc)	Vibration	Endurance by sweeping f = 10 Hz to 2000 Hz; no resonance; A $\leq 1.5$ mm $\leq 200$ m/s <sup>2</sup> ; 7.5 h			$\pm (0.25 \% R + 0.05 \Omega)$ no visible damage	$\pm (0.5 \% R + 0.05 \Omega)$ no visible damage
4.17	58 (Td)	Solderability	Solder bath method, SnPb40; non-activated flux (235 $\pm$ 5) °C; (2 $\pm$ 0.2) s			Good tinning ( $\geq 95$ % covered); no visible damage	
			Solder bath method, Sn96.5Ag3Cu0.5; non-activated flux (245 $\pm$ 5) °C; (3 $\pm$ 0.3) s				
4.18	58 (Td)	Resistance to soldering heat	Soldering bath method; (260 $\pm$ 5) °C; (10 $\pm$ 1) s			$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (0.5 \% R + 0.05 \Omega)$

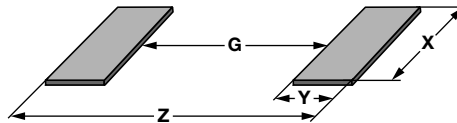
TEST PROCEDURES AND REQUIREMENTS						
EN 60115-1 CLAUSE	IEC 60082-2 <sup>(1)</sup> TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R$ )		
				STABILITY CLASS 1 OR BETTER		STABILITY CLASS 2 OR BETTER
				Stability for product types:		
<b>RCV e3</b>						
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol; +50 °C; method 2	No visible damage		
4.32	21 (Uu <sub>3</sub> )	Shear (adhesion)	17.7 N	No visible damage		
4.33	21 (Uu <sub>1</sub> )	Substrate bending	Depth 2 mm; 3 times	RCV0805, RCV1206: $\pm (0.25 \% R + 0.05 \Omega)$ RCV2010: $\pm (1 \% R + 0.05 \Omega)$ no visible damage, no open circuit in bent position		
4.7	-	Voltage proof	$U = 1.4 \times U_{ins}$ ; 60 s	No flashover or breakdown		
4.35	-	Flammability, needle flame test	IEC 60695-11-5 <sup>(1)</sup> ; 10 s	No burning after 30 s		

**Note**

<sup>(1)</sup> 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)
RCV0805 e3	2.0 + 0.20 / - 0.10	1.25 $\pm$ 0.15	0.45 $\pm$ 0.05	0.3 + 0.20 / - 0.10	0.3 $\pm$ 0.20	5.5
RCV1206 e3	3.2 + 0.20 / - 0.10	1.6 $\pm$ 0.15	0.55 $\pm$ 0.05	0.45 $\pm$ 0.20	0.4 $\pm$ 0.20	10
RCV2010 e3	5.0 $\pm$ 0.15	2.5 $\pm$ 0.15	0.6 $\pm$ 0.10	0.6 $\pm$ 0.20	0.45 $\pm$ 0.20	25.5

**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)
RCV0805 e3	0.90	1.30	1.60	3.50	1.00	0.95	1.45	2.90
RCV1206 e3	1.40	1.40	1.95	4.20	1.50	1.05	1.80	3.60
RCV2010 e3	3.60	1.65	2.85	6.90	3.70	1.20	2.70	6.10

**Note**

- Utilization of the full specified operating voltage may require special considerations on the creepage and clearance distance between conductors at different potential levels



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