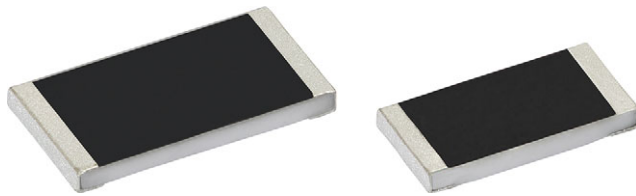




High Voltage (Up to 3 kV) Thick Film Chip Resistors



FEATURES

- High operating voltage (up to 3 kV)
- Low voltage coefficient of resistance (VCR): 25 ppm/V
- AEC-Q200 qualified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS COMPLIANT HALOGEN FREE

LINKS TO ADDITIONAL RESOURCES



The RCV-AT e3 high voltage thick film chip resistors series is the perfect choice for modern electronics with high voltage requirements. Typical applications include automotive inverters for H(EV) cars, voltage measurement systems as implemented in on board chargers, and DC-DC converters.

APPLICATIONS

- Inverters for (H)EV cars
- On board chargers
- DC-DC converters

TECHNICAL SPECIFICATIONS			
DESCRIPTION	RCV1206-AT e3	RCV2010-AT e3	RCV2512-AT e3
Imperial size	1206	2010	2512
Metric size code	RR3216M	RR5025M	RR6332M
Resistance range	100 kΩ to 51 MΩ	100 kΩ to 100 MΩ	
Resistance tolerance	± 5 %; ± 1 %		
Temperature coefficient	± 200 ppm/K; ± 100 ppm/K		
Voltage coefficient	25 ppm/V		
Rated dissipation, P_{70} ⁽¹⁾	0.33 W	0.75 W	1.0 W
Operating voltage, U_{max} AC _{RMS} /DC	800 V	2000 V	3000 V
Permissible film temperature, $\vartheta_{F max}$ ⁽¹⁾	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	≤ 2.0 %		
Permissible voltage against ambient (insulation): 1 min, U_{ins}	500 V		
Failure rate: FIT _{observed}	≤ 0.1 x 10 ⁻⁹ /h		

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.



TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
TYPE / SIZE	TCR	TOLERANCE	RESISTANCE	E-SERIES
RCV1206-AT e3	± 200 ppm/K	± 5 %	100 kΩ to 51 MΩ	E24
	± 100 ppm/K	± 1 %	100 kΩ to 10 MΩ	E24; E96
RCV2010-AT e3	± 200 ppm/K	± 5 %	100 kΩ to 100 MΩ	E24
	± 100 ppm/K	± 1 %	100 kΩ to 10 MΩ	E24; E96
RCV2512-AT e3	± 200 ppm/K	± 5 %	100 kΩ to 100 MΩ	E24
	± 100 ppm/K	± 1 %	100 kΩ to 10 MΩ	E24; E96

PACKAGING						
TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS
RCV1206-AT e3	EA = ET1	5000	Paper tape according to IEC 60286-3, type 1a	8 mm	4 mm	Ø 180 mm / 7"
	EC = ET6	20 000				Ø 330 mm / 13"
RCV2010-AT e3	EF = E02	4000	Blister tape according to IEC 60286-3, type 2a	12 mm	4 mm	Ø 180 mm / 7"
RCV2512-AT e3	EG = E67	2000			8 mm	Ø 180 mm / 7"
	EH = E82	4000			4 mm	

PART NUMBER AND PRODUCT DESCRIPTION																
Part Number: RCV2010100KFKEFAT																
R	C	V	2	0	1	0	1	0	0	K	F	K	E	F	A	T
TYPE / SIZE	RESISTANCE	TOLERANCE	TCR	PACKAGING	VERSION											
RCV1206 RCV2010 RCV2512	K = thousand M = million	F = ± 1 % J = ± 5 %	K = ± 100 ppm/K N = ± 200 ppm/K	EA, EC, EF, EG, EH	AT = automotive											
Product Description: RCV2010-AT 100 100K 1 % E02 e3																
RCV2010-AT	100	100K	1 %	E02	e3											
TYPE / SIZE	TCR	RESISTANCE	TOLERANCE	PACKAGING	LEAD (Pb)-FREE											
RCV1206-AT RCV2010-AT RCV2512-AT	± 100 ppm/K ± 200 ppm/K	100K = 100 kΩ 1M = 1 MΩ 100M = 100 MΩ	± 1 % ± 5 %	ET1, ET6, E02, E67, E82	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 (Al₂O₃) 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 and 2a** ⁽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.

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>

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

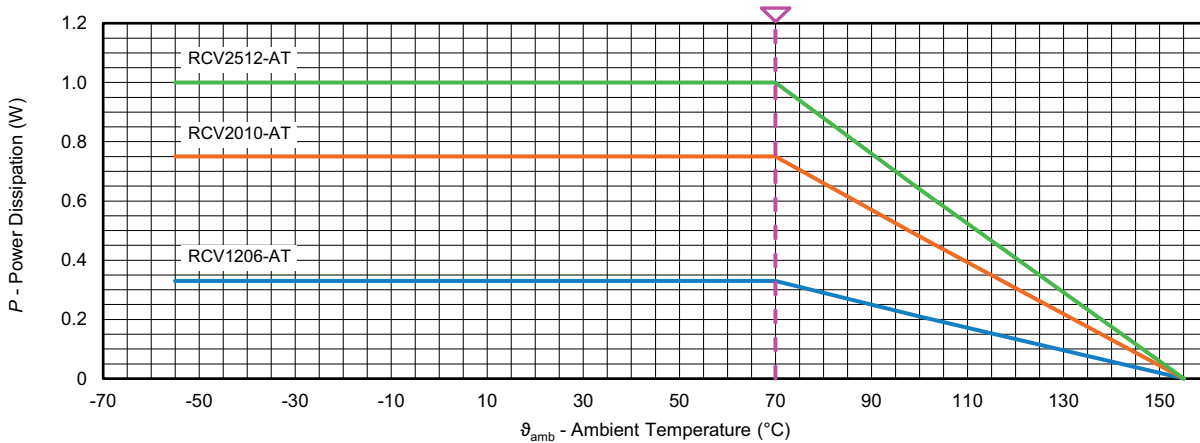
For non-automotive product version, please refer to RCV e3, High Voltage (Up to 2 kV) Thick Film Chip Resistors datasheet, www.vishay.com/doc?20054.

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.

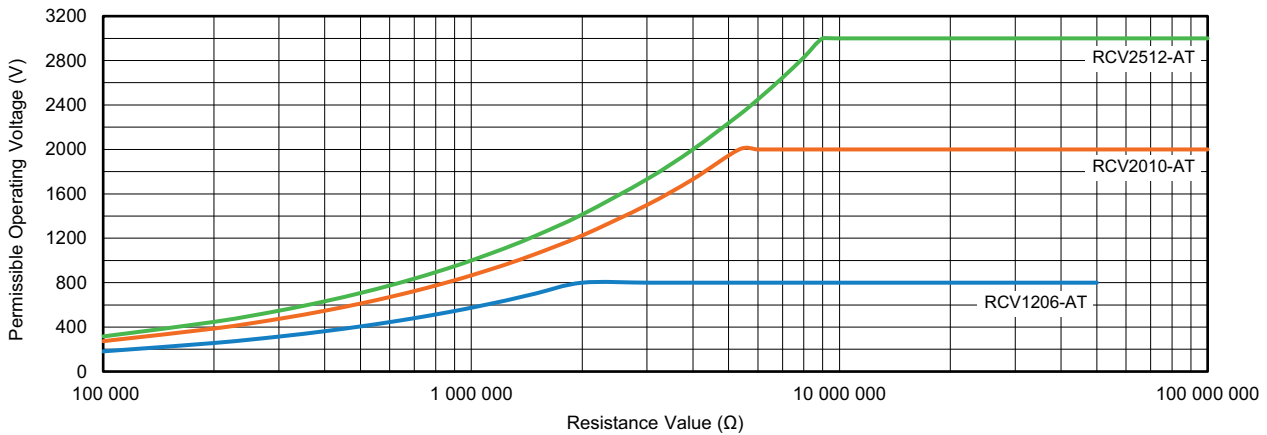
For professional high voltage thin film, please refer to latest edition of MMA 0204 HV, MMB 0207 HV - Professional, Professional High Voltage Thin Film MELF Resistors datasheet, www.vishay.com/doc?28880.

For tighter precision specification, automotive high voltage thin film, please refer to latest edition of MMA 0204 HV AT, MMB 0207 HV AT, Precision Automotive High Voltage Thin Film MELF Resistors datasheet, www.vishay.com/doc?28951.

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, 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).



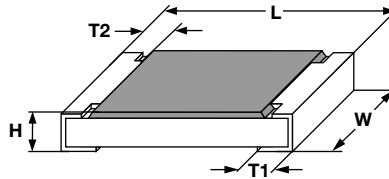
TEST PROCEDURES AND REQUIREMENTS							
EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE		REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
					STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER	
			Stability for product types:		100 k Ω to 100 M Ω		
		RVC-AT e3					
6.1	-	Measurements of resistance and tolerance	-		$\pm 1\%$	$\pm 5\%$	
6.2	-	Temperature coefficient of resistance	At (20 / -55 / 20) °C and (20 / 155 / 20) °C		± 100 ppm/K	± 200 ppm/K	
7.1	-	Endurance at rated temperature 70 °C	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off; 70 °C; 1000 h; 70 °C; 8000 h		$\pm (2\% R + 0.1 \Omega)$ $\pm (4\% R + 0.1 \Omega)$		
7.3	-	Endurance at maximum temperature	155 °C; 1000 h		$\pm (1\% R + 0.05 \Omega)$	$\pm 2\% R + 0.1 \Omega$	
10.4	78 (Cab)	Damp heat, steady state	(40 \pm 2) °C; 56 days; (93 \pm 3) % RH		$\pm (1\% R + 0.05 \Omega)$	$\pm 2\% R + 0.1 \Omega$	
10.5	67 (Cy)	Damp heat, steady state, accelerated	(85 \pm 2) °C; (85 \pm 5) % RH, 1000 h $U = \sqrt{0.1 \times P_{85} \times R}$ (for $U_R < 500$ V) $U = 0.1 \times \sqrt{P_{85} \times R}$ (for $U_R \geq 500$ V) (2)		$\pm (2\% R + 0.1 \Omega)$		
10.3	-	Climatic sequence:					
10.3.4.2	2 (Bb)	Dry heat	125 °C; 16 h				
10.3.4.3	30 (Db)	Damp heat, cyclic	55 °C; 24 h; $\geq 90\%$ RH; 1 cycle				
10.3.4.4	1 (Ab)	Cold	-55 °C; 2 h				
10.3.4.5	13 (M)	Low air pressure	8.5 kPa; 2 h; (25 \pm 10) °C		$\pm (2\% R + 0.1 \Omega)$		
10.3.4.6	30 (Db)	Damp heat, cyclic	55 °C; 5 days; > 90 % RH; 5 cycles				
10.3.4.7	-	DC load	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1 min				
-	1 (Aa)	Cold	-55 °C; 2 h		$\pm (0.5\% R + 0.05 \Omega)$		
10.1	14 (Na)	Rapid change of temperature	30 min. at -55 °C and 30 min. at 125 °C; 1000 cycles		$\pm (1\% R + 0.05 \Omega)$; 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		$\pm (2\% R + 0.05 \Omega)$		
			Style	Duration			Maximum U_{OL}
			RVC1206-AT	5 s			1600
			RVC2010-AT	5 s			4000
			RVC2512-AT	5 s	6000		
8.2	-	Single pulse high voltage overload	Severity no. 4: $U \leq 10 \times \sqrt{P_{70} \times R}$ or $U \leq 2 \times U_{max.}$; whichever is the less severe; 10 pulses 10 μ s / 700 μ s		$\pm (2\% R + 0.1 \Omega)$; no visible damage		
8.4	-	Periodic electric overload	$U \leq \sqrt{15 \times P_{70} \times R}$ or $U \leq 2 \times U_{max.}$; whichever is the less severe; 0.1 s on; 2.5 s off; 1000 cycles		$\pm (2\% R + 0.05 \Omega)$		



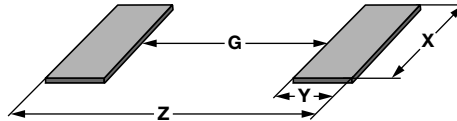
TEST PROCEDURES AND REQUIREMENTS						
EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE		REQUIREMENTS PERMISSIBLE CHANGE (ΔR)	
					STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER
			Stability for product types:			100 k Ω to 100 M Ω
RCV-AT e3						
8.5	-	Electrostatic discharge (human body model)	IEC 61340-3-1 (1); 3 positive + 3 negative discharges;		$\pm (1 \% R + 0.05 \Omega)$	
			Size	Voltage		
			RCV1206-AT	6 kV		
			RCV2010-AT	12 kV		
			RCV2512-AT	25 kV		
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		$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (1 \% R + 0.05 \Omega)$
11.1	58 (Td)	Solderability	Solder bath method, SnPb40; non-activated flux (235 \pm 5) °C; (2 \pm 0.2) s		Good tinning (95 % covered); no visible damage	
			Solder bath method, Sn96.5Ag3Cu0.5; non-activated flux (245 \pm 5) °C; (3 \pm 0.3) s			
11.2	58 (Td)	Resistance to soldering heat	Soldering bath method; (260 \pm 5) °C; (10 \pm 1) s		$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (0.5 \% R + 0.05 \Omega)$
11.3	45 (XA)	Component solvent resistance	Isopropyl alcohol +50 °C; method 2		No visible damage	
9.7	21 (Uu ₃)	Shear (adhesion)	17.7 N		No visible damage	
9.8	21 (Uu ₁)	Substrate bending	Depth 2 mm; 3 times		RCV1206-AT e3: $\pm (0.25 \% R + 0.05 \Omega)$ RCV2010-AT e3 and RCV2512-AT e3: $\pm (1 \% R + 0.05 \Omega)$ no visible damage, no open circuit in bent position	
12.2	-	Voltage proof	$U = 1.4 \times U_{Ins}$; 60 s		No flashover or breakdown	
12.4	-	Flammability, needle flame test	IEC 60695-11-5 (1); 10 s		No burning after 30 s	

Notes

- (1) The quoted IEC standards are also released as EN standards with the same number and identical contents
- (2) Test in accordance to AEC-Q200, rev. E

DIMENSIONS


DIMENSIONS AND MASS						
TYPE / SIZE	L (mm)	W (mm)	H (mm)	T1 (mm)	T2 (mm)	MASS (mg)
RCV1206-AT e3	3.2 + 0.10 / - 0.20	1.6 ± 0.15	0.55 ± 0.05	0.45 ± 0.20	0.4 ± 0.20	10
RCV2010-AT e3	5.0 ± 0.15	2.5 ± 0.15	0.6 ± 0.10	0.6 ± 0.20	0.45 ± 0.20	25.5
RCV2512-AT e3	6.3 ± 0.20	3.15 ± 0.15	0.6 ± 0.10	0.6 ± 0.20	0.45 ± 0.20	42

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)
RCV1206-AT e3	1.40	1.40	1.95	4.20	1.50	1.05	1.80	3.60
RCV2010-AT e3	3.60	1.65	2.85	6.90	3.70	1.20	2.70	6.10
RCV2512-AT e3	4.90	1.60	3.50	8.10	5.00	1.25	3.35	7.50

Note

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



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.