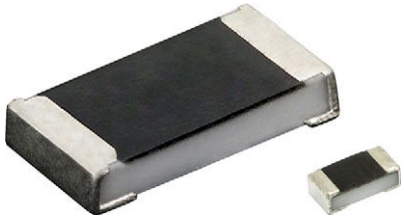
Green Thick Film Chip Resistors



FEATURES

- Vishay Green resistor - does not use RoHS exemptions
- Stability at different environmental conditions $\Delta R/R \leq 1$ % (1000 h rated power at 70 °C)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

HALOGEN FREE GREEN (5-2008)

LINKS TO ADDITIONAL RESOURCES

3D Models

APPLICATIONS

- Consumer
- Connectivity

RCG e3 series Vishay Green thick film chip resistors are the perfect choice for commercial applications where fully RoHS-compliant products are required. Typical applications include consumer and connectivity applications.

TECHNICAL SPECIFICATIONS

DESCRIPTION	RCG0402 e3	RCG0603 e3	RCG0805 e3	RCG1206 e3
Imperial size	0402	0603	0805	1206
Metric size code	RR1005M	RR1608M	RR2012M	RR3216M
Resistance range	1 Ω to 10 MΩ; jumper (0 Ω)			
Resistance tolerance	± 5 %; ± 1 %; ± 0.5 %			
Temperature coefficient	± 200 ppm/K; ± 150 ppm/K; ± 100 ppm/K			
Rated dissipation, P_{70} (1)	0.063 W	0.10 W	0.125 W	0.25 W
Operating voltage, $U_{max.}$ AC_{RMS}/DC	50 V	75 V	150 V	200 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, $\lvert\Delta R/R\rvert$ after: 1000 h	≤ 2 %			
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.

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TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

TYPE / SIZE	TCR	TOLERANCE	RESISTANCE	E-SERIES
RCG0402 e3	± 200 ppm/K	± 5 %	1 Ω to 10 MΩ	E24
	± 150 ppm/K	± 1 %	1 Ω to 147 Ω	E24; E96
		± 0.5 %		
	± 100 ppm/K	± 1 %	150 Ω to 10 MΩ	
		± 0.5 %		
	Jumper, $I_{max.}$ = 1.5 A	≤ 20 mΩ	0 Ω	-
RCG0603 e3	± 200 ppm/K	± 5 %	1 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %		E24; E96
		± 0.5 %		
	Jumper, $I_{max.}$ = 2 A	≤ 20 mΩ	0 Ω	-
RCG0805 e3	± 200 ppm/K	± 5 %	1 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %		E24; E96
		± 0.5 %		
	Jumper, $I_{max.}$ = 2.5 A	≤ 20 mΩ	0 Ω	-
RCG1206 e3	± 200 ppm/K	± 5 %	1 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %		E24; E96
		± 0.5 %		
	Jumper, $I_{max.}$ = 3.5 A	≤ 20 mΩ	0 Ω	-

Note

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

PACKAGING

TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS
RCG0402 e3	ED	10 000	Paper tape acc. to IEC 60286-3, Type 1a	8 mm	2 mm	180 mm / 7"
	EE	50 000				330 mm / 13"
RCG0603 e3	EI	5000		8 mm	2 mm	180 mm / 7"
	ED	10 000				180 mm / 7"
	EL	20 000				285 mm / 11.25"
	EE	50 000				330 mm / 13"
	EA	5000			4 mm	180 mm / 7"
	EB	10 000				285 mm / 11.25"
	EC	20 000				330 mm / 13"
RCG0805 e3	EA	5000		8 mm	4 mm	180 mm / 7"
	EB	10 000				285 mm / 11.25"
	EC	20 000				330 mm / 13"
RCG1206 e3	EA	5000		8 mm	4 mm	180 mm / 7"
	EB	10 000				285 mm / 11.25"
	EC	20 000				330 mm / 13"

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: RCG080510K0FKEA

R	C	G	0	8	0	5	1	0	K	0	F	K	E	A

TYPE / SIZE	RESISTANCE	TOLERANCE	TCR	PACKAGING
RCG0402 **RCG0603** **RCG0805** **RCG1206**	**R** = decimal **K** = thousand **M** = million **0000** = 0 Ω jumper	**D** = ± 0.5 % **F** = ± 1.0 % **J** = ± 5.0 % **Z** = jumper	**K** = ± 100 ppm/K **L** = ± 150 ppm/K **N** = ± 200 ppm/K **0** = jumper	**EA, EB, EC, ED,** **EE, EI, EL**

Product Description: RCG0805 100 10K 1 % EA

RCG0805	100	10K	1 %	EA
TYPE / SIZE	TCR	RESISTANCE	TOLERANCE	PACKAGING
RCG0402 **RCG0603** **RCG0805** **RCG1206**	**± 100** ppm/K **± 150** ppm/K **± 200** ppm/K	**10R** = 10 Ω **10K** = 10 kΩ **1M** = 1 MΩ **0R0** = jumper	**± 0.5 %** **± 1 %** **± 5 %**	**EA, EB, EC, ED,** **EE, EI, EL**

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DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A Vishay Green cermet film layer and a glass-over are deposited on a high grade (Al_2O_3) ceramic substrate with its prepared inner Vishay Green contacts. 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**.

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 fully 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 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

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 RoHS-compliant thick film resistors please refer to “D/CRCW e3, Standard Thick Film Chip Resistors” datasheet (www.vishay.com/doc?20035).

For RoHS-compliant thick film chip resistors with medium power rating and operating voltage, please refer to “RCC e3 Medium Power Thick Film Chip Resistors” datasheet (www.vishay.com/docs?20066).

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

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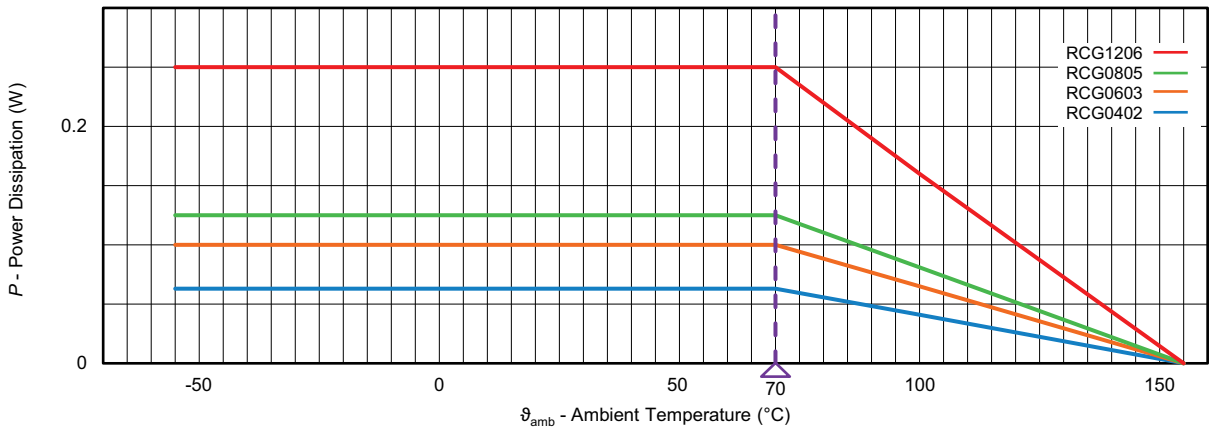
FUNCTIONAL PERFORMANCE

Derating



VISHAY GREEN REQUIREMENTS	
SUBSTANCES	**CONCENTRATION LIMIT**
Lead (Pb)	< 1000 ppm
Mercury (Hg)	< 1000 ppm
Cadmium (Cd)	< 100 ppm
Hexavalent chronium	< 1000 ppm
Polybrominated biphenyl (PBB)	< 1000 ppm
Polybrominated diphenyl ether (PBDE)	< 1000 ppm
Bromine (Br)	< 900 ppm
Chlorine (Cl)	< 900 ppm
Sum of bromine and chlorine	≤ 1500 ppm
Antimony (Sb)	< 900 ppm
Red phosphorous	< 100 ppm

Notes

- No exemptions (e.g. Pb in glass) may be applied to any substances or application for the “Vishay Green” category
- All concentration levels are based on homogenous materials

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). The components are mounted for testing on boards in accordance with EN 60115-8, 2.4.2 unless otherwise specified.

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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:	1 Ω to 10 MΩ	
			RCG e3		
4.5	-	Resistance	-	± 0.5 %; ± 1 %	± 5 %
4.8	-	Temperature coefficient	At (20 / -55 / 20) °C and (20 / 125 / 20) °C	± 100 ppm/K; ± 150 ppm/K	± 500 ppm/K
4.25.1	-	Endurance at 70 °C	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1.5 h on; 0.5 h off 70 °C; 1000 h	± (1 % R + 0.05 Ω)	± (2 % R + 0.1 Ω)
4.25.3	-	Endurance at upper category temperature	155 °C; 1000 h	± (1 % R + 0.05 Ω)	± (2 % R + 0.1 Ω)
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; (93 ± 3) % RH; 56 days	± (1 % R + 0.05 Ω)	± (1 % R + 0.1 Ω)
4.23	-	Climatic sequence:		± (1 % R + 0.05 Ω)	± (2 % R + 0.1 Ω)
4.23.2	2 (Ba)	Dry heat	125 °C; 16 h		
4.23.3	30 (Db)	Damp heat, cyclic	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		
4.23.6	30 (Db)	Damp heat, cyclic	55 °C; 5 days; > 90 % RH; 5 cycles		
4.23.7	-	DC load	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1 min		
-	1 (Aa)	Cold	-55 °C; 2 h	± (0.5 % R + 0.1 Ω)	
4.19	14 (Na)	Rapid change of temperature	30 min. at -55 °C and 30 min. at 125 °C; 1000 cycles	± (1 % R + 0.05 Ω)	
4.13	-	Short time 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)	
4.27	-	Single pulse high voltage overload	Severity no. 4: $U = 10 \times \sqrt{P_{70} \times R}$ or $U \leq 2 \times U_{max.}$; whichever is the less severe; 10 pulses 10 µs / 700 µs	± (1 % R + 0.05 Ω)	
4.39	-	Periodic electric overload	$U = \sqrt{15 \times P_{70} \times R} \leq 2 \times U_{max.}$; whichever is the less severe; 0.1 s on; 2.5 s off; 1000 cycles	± (1 % R + 0.05 Ω)	
4.38	-	Electrostatic discharge (human body model)	IEC 61340-3-1 (1); 3 positive + 3 negative discharges; ESD voltage acc. to size	± (1 % R + 0.05 Ω)	
4.22	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
4.17	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, Sn96.5Ag3Cu0.5 or Sn99.3Cu0.7 non-activated flux; (245 ± 5) °C or (250 ± 5) °C; (3 ± 0.3) s		
4.18	58 (Td)	Resistance to soldering heat	Solder bath method; (260 ± 5) °C; (10 ± 1) s	± (0.25 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol; 50 °C; method 2	No visible damage	
4.32	21 (Uu_3)	Shear (adhesion)	RCG0402 e3 and RCG0603 e3: 9 N RCG0805 e3 and RCG1206 e3: 45 N	No visible damage	
4.33	21 (Uu_1)	Substrate bending	Depth 2 mm; 3 times	No visible damage, no open circuit in bent position	
				± (0.25 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)
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 (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

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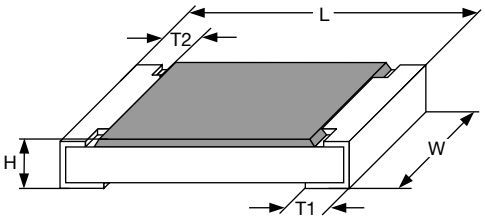
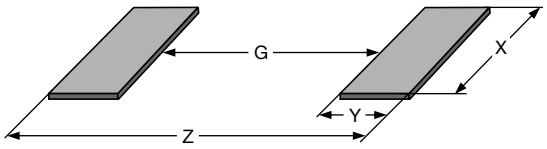
DIMENSIONS



DIMENSIONS AND MASS						
TYPE / SIZE	L (mm)	W (mm)	H (mm)	T1 (mm)	T2 (mm)	MASS (mg)
RCG0402 e3	1.0 ± 0.05	0.5 ± 0.05	0.35 ± 0.05	0.25 ± 0.10	0.2 ± 0.10	0.65
RCG0603 e3	1.55 + 0.10 / - 0.05	0.85 ± 0.1	0.45 ± 0.05	0.3 ± 0.20	0.3 ± 0.20	2
RCG0805 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
RCG1206 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)
RCG0402 e3	-	-	-	-	0.45	0.60	0.60	1.65
RCG0603 e3	0.65	1.10	1.25	2.85	0.75	0.75	1.00	2.25
RCG0805 e3	0.90	1.30	1.60	3.50	1.00	0.95	1.45	2.90
RCG1206 e3	1.40	1.40	1.95	4.20	1.50	1.05	1.80	3.60

Note

- The rated dissipation applies only if the permitted film temperature is not exceeded. Furthermore, a high level of ambient temperature or of power dissipation may raise the temperature of the solder joint, hence special solder alloys or board materials may be required to maintain the reliability of the assembly.
  The given solder pad dimensions reflect the considerations for board design and assembly as outlined e.g. in standards IEC 61188-5-x or in publication IPC-7351. They do not guarantee any supposed thermal properties, particularly as these are also strongly influenced by many other parameters. Still, the given solder pad dimensions will be found adequate for most general applications

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