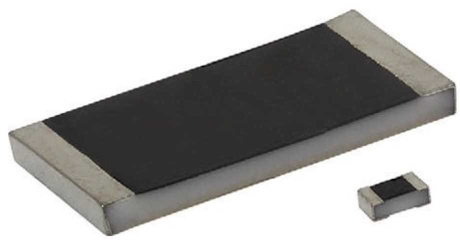
Pulse Proof, High Power Thick Film Chip Resistors



LINKS TO ADDITIONAL RESOURCES

3D Models

The pulse proof, high power thick film chip resistors series is the perfect choice for most fields of power measurement electronics where reliability, stability, high power rating and excellent pulse load performance are of major concern. Typical applications include battery management systems in automotive appliances.

FEATURES

- Excellent pulse load capability
- Enhanced power rating
- Double side printed resistor element
- AEC-Q200 qualified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT
HALOGEN FREE

APPLICATIONS

- Automotive
- Industrial
- Commercial
- High power

TECHNICAL SPECIFICATIONS

DESCRIPTION	CRCW0402-HP e3	CRCW0603-HP e3	CRCW0805-HP e3	CRCW1206-HP e3	CRCW1210-HP e3	CRCW1218-HP e3	CRCW2010-HP e3	CRCW2512-HP e3
Imperial size	0402	0603	0805	1206	1210	1218	2010	2512
Metric size code	RR1005M	RR1608M	RR2012M	RR3216M	RR3225M	RR3246M	RR5025M	RR6332M
Resistance range	1 Ω to 1 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 (2)	0.33 W	0.5 W	0.75 W (3)	0.75 W	1.5 W	1.0 W	1.5 W
Operating voltage, $U_{max.}$ AC_{RMS}/DC	50 V	75 V	150 V	200 V	200 V	200 V	400 V	500 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	≤ 2.0 %							
8000 h	≤ 4.0 %							
Permissible voltage against ambient (insulation): 1 min, U_{ins}	75 V	100 V	200 V	300 V	300 V	300 V	300 V	300 V
Failure rate: FIT $_{observed}$	≤ 0.1 x 10^{-9}/h							

Notes

(1) Please refer to APPLICATION INFORMATION below

(2) CRCW0402-HP resistors feature a single side printed resistive layer only, except jumpers

(3) Specified power rating requires a thermal resistance of $R_{th} \leq$ 110 K/W

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
CRCW0402-HP e3	± 200 ppm/K	± 5 %	1 Ω to 1 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 1 MΩ	E24; E96
		± 0.5 %		
	Jumper, $I_{max.}$ = 3 A	≤ 10 mΩ	0 Ω	-
CRCW0603-HP e3	± 200 ppm/K	± 5 %	1 Ω to 1 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 1 MΩ	E24; E96
		± 0.5 %		
	Jumper, $I_{max.}$ = 5 A	≤ 8 mΩ	0 Ω	-
CRCW0805-HP e3	± 200 ppm/K	± 5 %	1 Ω to 1 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 1 MΩ	E24; E96
		± 0.5 %		
	Jumper, $I_{max.}$ = 6 A	≤ 5 mΩ	0 Ω	-
CRCW1206-HP e3	± 200 ppm/K	± 5 %	1 Ω to 1 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 1 MΩ	E24; E96
		± 0.5 %		
	Jumper, $I_{max.}$ = 10 A	≤ 5 mΩ	0 Ω	-
CRCW1210-HP e3	± 200 ppm/K	± 5 %	1 Ω to 1 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 1 MΩ	E24; E96
		± 0.5 %		
	Jumper, $I_{max.}$ = 12 A	≤ 4 mΩ	0 Ω	-
CRCW1218-HP e3	± 200 ppm/K	± 5 %	1 Ω to 1 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 1 MΩ	E24; E96
		± 0.5 %		
	Jumper, $I_{max.}$ = 20 A	≤ 4 mΩ	0 Ω	-
CRCW2010-HP e3	± 200 ppm/K	± 5 %	1 Ω to 1 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 1 MΩ	E24; E96
		± 0.5 %		
	Jumper, $I_{max.}$ = 12 A	≤ 5 mΩ	0 Ω	-
CRCW2512-HP e3	± 200 ppm/K	± 5 %	1 Ω to 1 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 1 MΩ	E24; E96
		± 0.5 %		
	Jumper, $I_{max.}$ = 16 A	≤ 5 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
CRCW0402-HP e3	ED = ET7	10 000	Paper tape acc. to IEC 60286-3, type 1a	8 mm	2 mm	Ø 180 mm / 7"
	EE = EF4	50 000				Ø 330 mm / 13"
CRCW0603-HP e3	EI = ET2	5000			2 mm	Ø 180 mm / 7"
	ED = ET3	10 000				Ø 180 mm / 7"
	EE = ET8	20 000				Ø 330 mm / 13"
	EA = ET1	5000			4 mm	Ø 180 mm / 7"
	EC = ET6	20 000				Ø 330 mm / 13"
CRCW0805-HP e3	EA = ET1	5000			4 mm	Ø 180 mm / 7"
	EC = ET6	20 000				Ø 330 mm / 13"
CRCW1206-HP e3	EA = ET1	5000			4 mm	Ø 180 mm / 7"
	EC = ET6	20 000				Ø 330 mm / 13"
CRCW1210-HP e3	EA = ET1	5000			4 mm	Ø 180 mm / 7"
	EC = ET6	20 000				Ø 330 mm / 13"
CRCW1218-HP e3	EK = ET9	4000	Blister tape acc. to IEC 60286-3, type 2a	12 mm	4 mm	Ø 180 mm / 7"
CRCW2010-HP e3	EF = E02	4000			4 mm	Ø 180 mm / 7"
	EJ = E08	16 000			4 mm	Ø 330 mm / 13"
CRCW2512-HP e3	EG = E67	2000			8 mm	Ø 180 mm / 7"
	EH = E82	4000			4 mm	

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PART NUMBER AND PRODUCT DESCRIPTION

Part Number: CRCW0603562RFKEAHP
Part Number: CRCW06030000Z0EAHP

C	R	C	W	0	6	0	3	5	6	2	R	F	K	E	A	H	P

TYPE / SIZE	VALUE	TOLERANCE	TCR	PACKAGING	SPECIAL
CRCW0402 **CRCW0603** **CRCW0805** **CRCW1206** **CRCW1210** **CRCW1218** **CRCW2010** **CRCW2512**	**R** = decimal **K** = thousand **M** = million **0000** = jumper	**D** = ± 0.5 % **F** = ± 1 % **J** = ± 5 % **Z** = jumper	**K** = ± 100 ppm/K **N** = ± 200 ppm/K **0** = jumper	**EA, EC, ED, EE, EF, EG, EI, EJ, EH, EK**	Up to 2 digits **HP** = pulse proof, high power

Product Description: CRCW0603-HP 100 562R 1 % ET1 e3
Product Description: CRCW0603-HP 0R0 ET1 e3

CRCW0603-HP	100	562R	1 %	ET1	e3
TYPE / SIZE	**TCR**	**RESISTANCE VALUE**	**TOLERANCE**	**PACKAGING**	**LEAD**
CRCW0402-HP **CRCW0603-HP** **CRCW0805-HP** **CRCW1206-HP** **CRCW1210-HP** **CRCW1218-HP** **CRCW2010-HP** **CRCW2512-HP**	± **100** ppm/K ± **200** ppm/K	**10R** = 10 Ω **562R** = 562 Ω **10K** = 10 kΩ **1M** = 1 MΩ **0R0** = jumper	**± 0.5 %** **± 1 %** **± 5 %**	**ET1, ET2, ET3, ET6, ET7, ET8, ET9, EF4, E02, E08, E67, E82**	**e3** = pure tin termination finish

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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 both sides of a high grade (Al_2O_3) ceramic substrate with its prepared inner contacts 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 Type 2a** [(1)].

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering 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 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 surge and pulse performance please refer to datasheet: D/CRCW-IF e3, Pulse Proof Thick Film Chip Resistors www.vishay.com/doc?20024.

For thick film resistors with standard requirements for power rating, please refer to datasheet:

D/CRCW e3, Standard Thick Film Chip www.vishay.com/doc?20035.

For anti-surge products and high power rating, please refer to datasheet:

RCS e3, Anti-Surge High Power Thick Film Chip Resistors www.vishay.com/doc?20065.

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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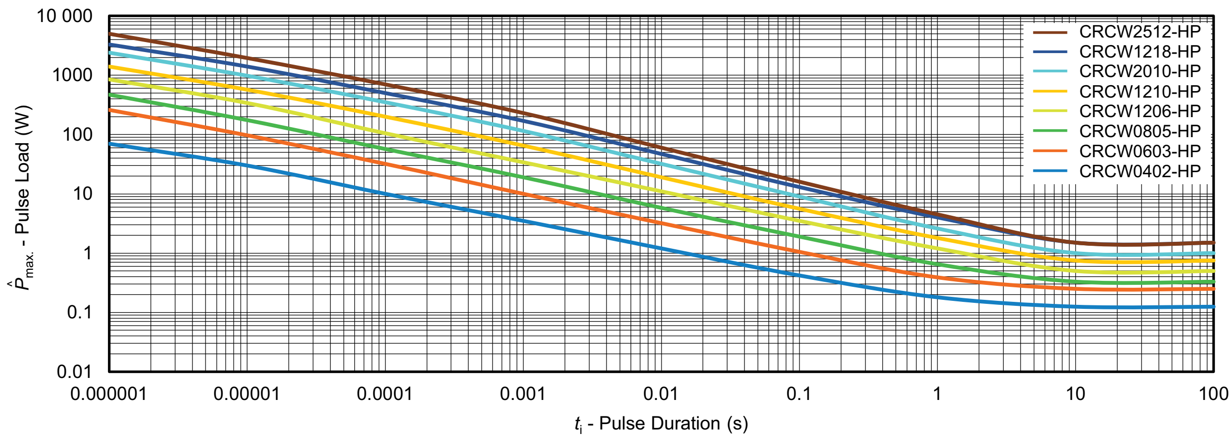
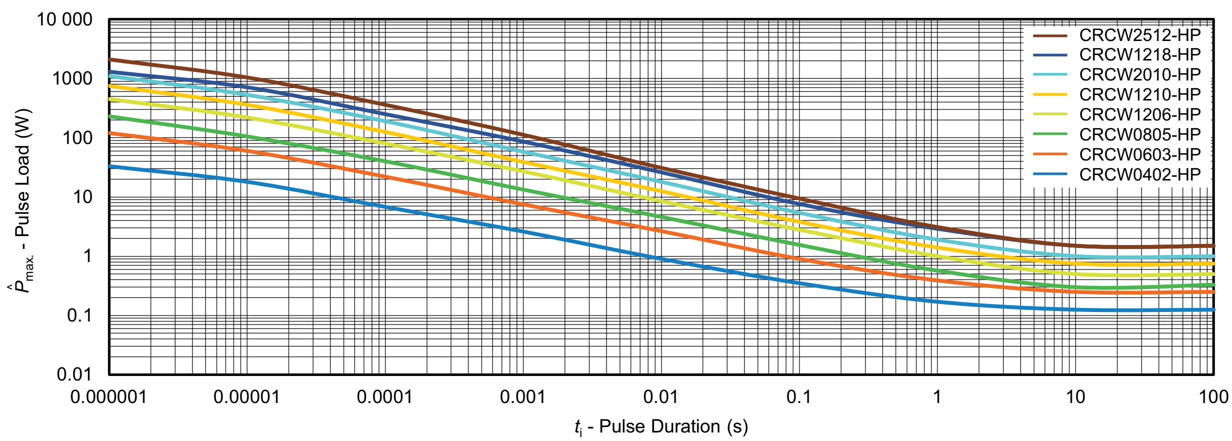
FUNCTIONAL PERFORMANCE

Single Pulse



Maximum pulse load, single pulse; applicable if $\bar{P} \rightarrow 0$ and $n < 1000$ and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change equivalent to 8000 h operation

Continuous Pulse



Maximum pulse load, continuous pulses; applicable if $\bar{P} \leq P(\vartheta_{amb})$ and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change equivalent to 8000 h operation

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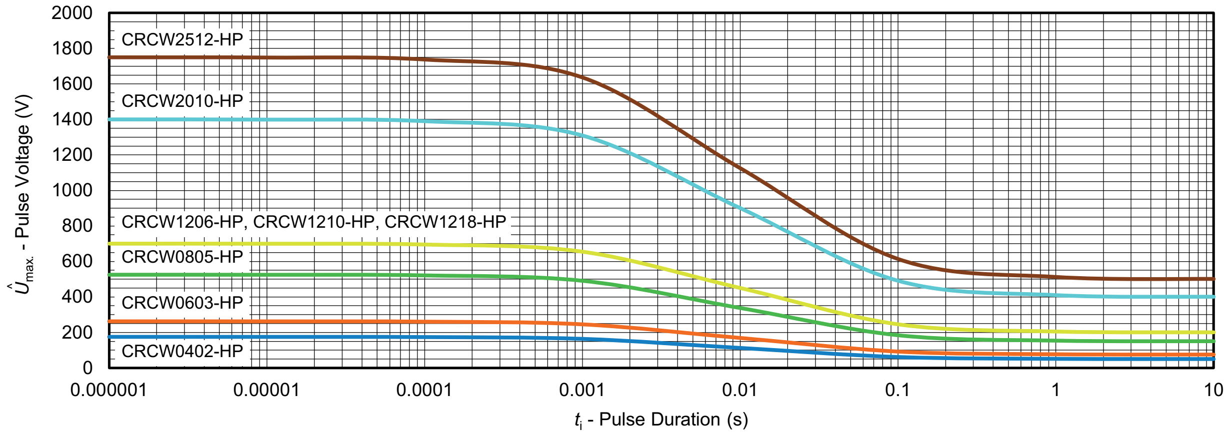
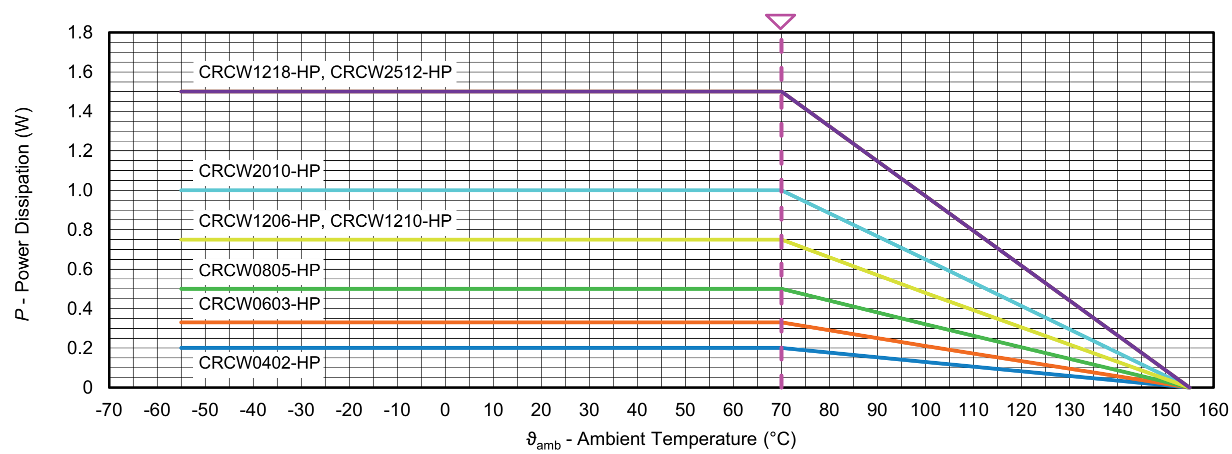
Pulse Voltage



Maximum pulse voltage, single and continuous pulses; applicable if $\hat{P} \le \hat{P}_{max.}$;
for permissible resistance change equivalent to 8000 h operation

Derating



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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

EN 60115-1 CLAUSE	IEC 60068-2 [1] TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)
			Stability for product types:	**STABILITY CLASS 2 OR BETTER**
			CRCW-HP e3	1 Ω to 1 MΩ
4.5	-	Resistance	-	± 0.5 %; ± 1 %; ± 5 %
4.8	-	Temperature coefficient	(20 / -55 / 20) °C and (20 / 155 / 20) °C	± 100 ppm/K; ± 200 ppm/K
4.25.1	-	Endurance at 70 °C	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off	
			70 °C; 1000 h	± (2 % R + 0.1 Ω)
			70 °C; 8000 h	± (4 % R + 0.1 Ω)
4.25.3	-	Endurance at upper category temperature	155 °C, 1000 h	± (2 % R + 0.1 Ω)
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH;	± (1 % R + 0.05 Ω)
4.37	67 (Cy)	Damp heat, steady state, accelerated	(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)
4.23	-	Climatic sequence:	-	± (2 % R + 0.1 Ω)
4.23.2	2 (Bb)	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; 24 h; ≥ 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 + 0.05 Ω)

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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 for product types:	STABILITY CLASS 2 OR BETTER
			CRCW-HP e3	1 Ω to 1 MΩ
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) no visible damage
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 $U = 2 \times U_{max.}$; whichever is the less severe; 10 pulses 10 μs/700 μs	± (1 % R + 0.05 Ω) no visible damage
4.39	-	Periodic electric overload	$U = \sqrt{15 \times P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 0.1 s on; 2.5 s off; 1000 cycles	± (1 % R + 0.05 Ω) no visible damage
4.38	-	Electrostatic discharge (human body model)	IEC 61340-3-1 [1]; 3 pos. + 3 neg. discharges; ESD voltage acc. to the 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	± (0.5 % 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 non-activated flux; (245 ± 5) °C; (3 ± 0.3) s	
4.18	58 (Td)	Resistance to soldering heat	Solder bath method (260 ± 5) °C; (10 ± 1) s	± (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)	CRCW0402-HP and CRCW0603-HP: 9 N CRCW0805-HP to CRCW2512-HP: 45 N	No visible damage
4.33	21 (Uu_1)	Substrate bending	Depth 2 mm; 3 times	± (0.25 % R + 0.05 Ω) 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 [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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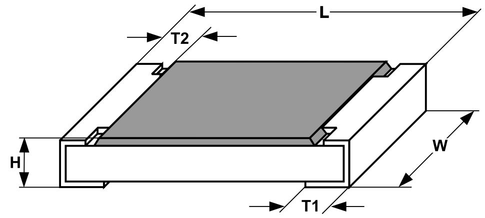
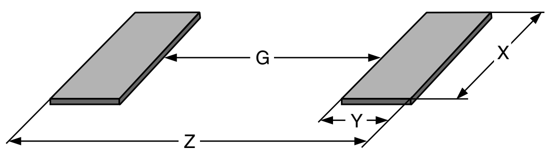
DIMENSIONS



DIMENSIONS AND MASS						
TYPE / SIZE	L (mm)	W (mm)	H (mm)	T1 (mm)	T2 (mm)	MASS (mg)
CRCW0402-HP e3	1.0 ± 0.05	0.5 ± 0.05	0.3 ± 0.10	0.25 ± 0.10	0.2 ± 0.10	0.65
CRCW0603-HP e3	1.6 ± 0.10	0.85 ± 0.10	0.45 ± 0.10	0.3 ± 0.20	0.3 ± 0.20	2
CRCW0805-HP e3	2.0 ± 0.15	1.25 ± 0.15	0.5 ± 0.10	0.4 ± 0.20	0.35 ± 0.20	5.5
CRCW1206-HP e3	3.1 ± 0.20	1.6 ± 0.15	0.5 ± 0.15	0.5 ± 0.20	0.45 ± 0.20	10
CRCW1210-HP e3	3.2 ± 0.20	2.5 ± 0.20	0.6 ± 0.10	0.45 ± 0.20	0.4 ± 0.20	18
CRCW1218-HP e3	3.1 ± 0.20	4.6 ± 0.20	0.6 ± 0.10	0.45 ± 0.20	0.4 ± 0.20	31
CRCW2010-HP e3	5.0 ± 0.15	2.5 ± 0.15	0.6 ± 0.10	0.6 ± 0.20	0.6 ± 0.20	25.5
CRCW2512-HP e3	6.3 ± 0.20	3.15 ± 0.15	0.6 ± 0.10	0.6 ± 0.20	0.6 ± 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)
CRCW0402-HP e3	-	-	-	-	0.45	0.6	0.6	1.65
CRCW0603-HP e3	0.65	1.10	1.25	2.85	0.75	0.75	1.00	2.25
CRCW0805-HP e3	0.90	1.30	1.60	3.50	1.00	0.95	1.45	2.90
CRCW1206-HP e3	1.40	1.40	1.95	4.20	1.50	1.05	1.8	3.60
CRCW1210-HP e3	1.80	1.45	2.95	4.70	1.70	1.10	2.80	3.90
CRCW1218-HP e3	1.60	1.50	5.10	4.60	1.70	1.10	4.90	3.90
CRCW2010-HP e3	3.60	1.65	2.85	6.90	3.70	1.20	2.70	6.10
CRCW2512-HP e3	4.90	1.60	3.50	8.10	5.00	1.25	3.35	7.50

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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