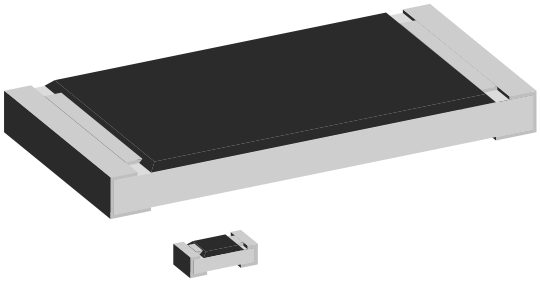
Lead (Pb)-Bearing Thick Film Chip Resistors



LINKS TO ADDITIONAL RESOURCES

3D Models

The lead (Pb)-bearing D/CRCW thick film chip resistors series are the perfect choice for most fields of modern electronics where lead (Pb)-bearing terminations are mandatory and high reliability and stability are of major concern.

Typical applications include military and industrial.

FEATURES

HALOGEN FREE

- Stability at different environmental conditions $\Delta R/R \leq 1$ % (1000 h rated power at 70 °C)
- AEC-Q200 qualified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Military
- Industrial

TECHNICAL SPECIFICATIONS

DESCRIPTION	D10/CRCW0402	D11/CRCW0603	D12/CRCW0805	D25/CRCW1206	CRCW1210	CRCW1218	CRCW2010	CRCW2512
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 10 MΩ; jumper (0 Ω)					1 Ω to 2.2 MΩ; jumper (0 Ω)	1 Ω to 10 MΩ; jumper (0 Ω)	
Resistance tolerance	± 5 %; ± 1 %							
Temperature coefficient	± 200 ppm/K; ± 100 ppm/K							
Rated dissipation, P_{70} (1)	0.063 W	0.10 W	0.125 W	0.25 W	0.5 W	1.0 W	0.75 W	1.0 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 (2):								
1000 h	≤ 1 %							
8000 h	≤ 2 %							
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) Apply to components with stability class 1

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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**
D10/CRCW0402	± 200 ppm/K	± 5 %	1 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 10 MΩ	E24; E96
	Jumper, $I_{max.}$ = 1.5 A	≤ 20 mΩ	0 Ω	-
D11/CRCW0603	± 200 ppm/K	± 5 %	1 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 10 MΩ	E24; E96
	Jumper, $I_{max.}$ = 2.0 A	≤ 20 mΩ	0 Ω	-
D12/CRCW0805	± 200 ppm/K	± 5 %	1 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 10 MΩ	E24; E96
	Jumper, $I_{max.}$ = 2.5 A	≤ 20 mΩ	0 Ω	-
D25/CRCW1206	± 200 ppm/K	± 5 %	1 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 10 MΩ	E24; E96
	Jumper, $I_{max.}$ = 3.5 A	≤ 20 mΩ	0 Ω	-
CRCW1210	± 200 ppm/K	± 5 %	1 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 10 MΩ	E24; E96
	Jumper, $I_{max.}$ = 5.0 A	≤ 20 mΩ	0 Ω	-
CRCW1218	± 200 ppm/K	± 5 %	1 Ω to 2.2 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 2.2 MΩ	E24; E96
	Jumper, $I_{max.}$ = 7.0 A	≤ 20 mΩ	0 Ω	-
CRCW2010	± 200 ppm/K	± 5 %	1 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 10 MΩ	E24; E96
	Jumper, $I_{max.}$ = 6.0 A	≤ 20 mΩ	0 Ω	-
CRCW2512	± 200 ppm/K	± 5 %	1 Ω to 10 MΩ	E24
	± 100 ppm/K	± 1 %	1 Ω to 10 MΩ	E24; E96
	Jumper, $I_{max.}$ = 7.0 A	≤ 20 mΩ	0 Ω	-

Note

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

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PACKAGING

TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS
D10/CRCW0402	TD = RT7 TE = RF4	10 000 50 000	Paper tape acc. to IEC 60286-3, Type 1a	8 mm	2 mm	Ø 180 mm / 7" Ø 330 mm / 13"
D11/CRCW0603	TA = RT1 TC = RT6	5000 20 000		8 mm	4 mm	Ø 180 mm / 7" Ø 330 mm / 13"
D12/CRCW0805	TA = RT1 TC = RT6	5000 20 000		8 mm	4 mm	Ø 180 mm / 7" Ø 330 mm / 13"
D25/CRCW1206	TA = RT1 TC = RT6	5000 20 000		8 mm	4 mm	Ø 180 mm / 7" Ø 330 mm / 13"
CRCW1210	TA = RT1 TC = RT6	5000 20 000		12 mm	4 mm	Ø 180 mm / 7" Ø 330 mm / 13"
CRCW1218	TK = RT9	4000	Blister tape acc. to IEC 60286-3, Type 2a	12 mm	4 mm	Ø 180 mm / 7"
CRCW2010	TF = R02	4000		12 mm	4 mm	Ø 180 mm / 7"
CRCW2512	TG = R67 TH = R82	2000 4000		12 mm	8 mm 4 mm	Ø 180 mm / 7"

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: CRCW0805562RFKTA
Part Number: CRCW08050000ZSTA

C	R	C	W	0	8	0	5	5	6	2	R	F	K	T	A		

TYPE / SIZE	RESISTANCE	TOLERANCE	TCR	PACKAGING	SPECIAL
CRCW0402 **CRCW0603** **CRCW0805** **CRCW1206** **CRCW1210** **CRCW1218** **CRCW2010** **CRCW2512**	**R** = decimal **K** = thousand **M** = million **0000** = jumper	**F** = ± 1 % **J** = ± 5 % **Z** = jumper	**K** = ± 100 ppm/K **N** = ± 200 ppm/K **S** = jumper	**TA, TC, TD, TE,** **TF, TG, TH, TK**	Up to 2 digits

Product Description: D12/CRCW0805 100 562R 1 % RT1
Product Description: D12/CRCW0805 0R0 RT1

D12/CRCW0805	**100**	**562R**	**1 %**	**RT1**
TYPE / SIZE	TCR	RESISTANCE	TOLERANCE	PACKAGING
D10/CRCW0402 **D11/CRCW0603** **D12/CRCW0805** **D25/CRCW1206** **CRCW1210** **CRCW1218** **CRCW2010** **CRCW2512**	± **100** ppm/K ± **200** ppm/K	**10R** = 10 Ω **562R** = 562 Ω **10K** = 10 kΩ **1M** = 1 MΩ **0R0** = jumper	± **1 %** ± **5 %**	**RT1, RT6, RT7,** **RF4, R02, R67,** **R82, RT9**

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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 a high grade (Al_2O_3) ceramic substrate with its prepared inner 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 SnPb layer 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 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 with SnPb plating provides compatibility with lead (Pb)-free and lead (Pb)-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

Except for the intentionally added lead (Pb) in the termination finish, 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.

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

The D/CRCW e3 with lead (Pb)-free termination plating is designed for applications where lead (Pb)-free terminations are mandatory. For ordering D/CRCW with lead (Pb)-free terminations please refer to latest edition of datasheet D/CRCW e3 (www.vishay.com/doc?20035).

For more information about products with better TCR and tighter tolerance please refer to the “Lead (Pb)-Bearing Thick Film, Rectangular, Semi-Precision Chip Resistors” datasheet (www.vishay.com/doc?20009).

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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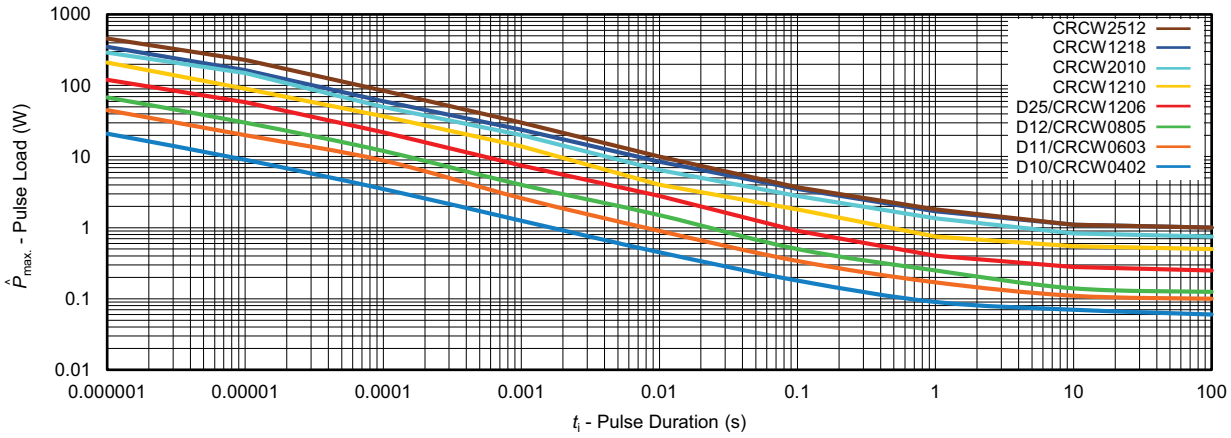
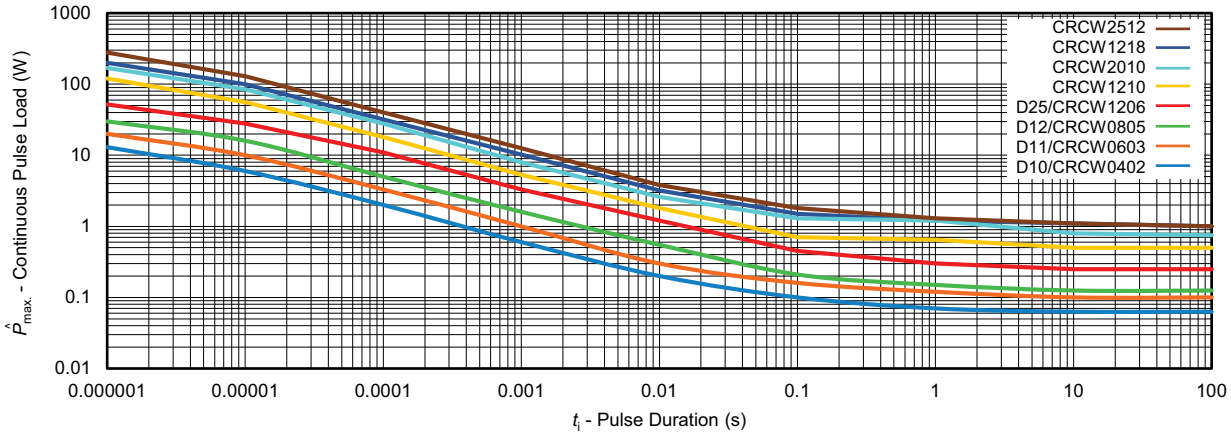
FUNCTIONAL PERFORMANCE

Single Pulse



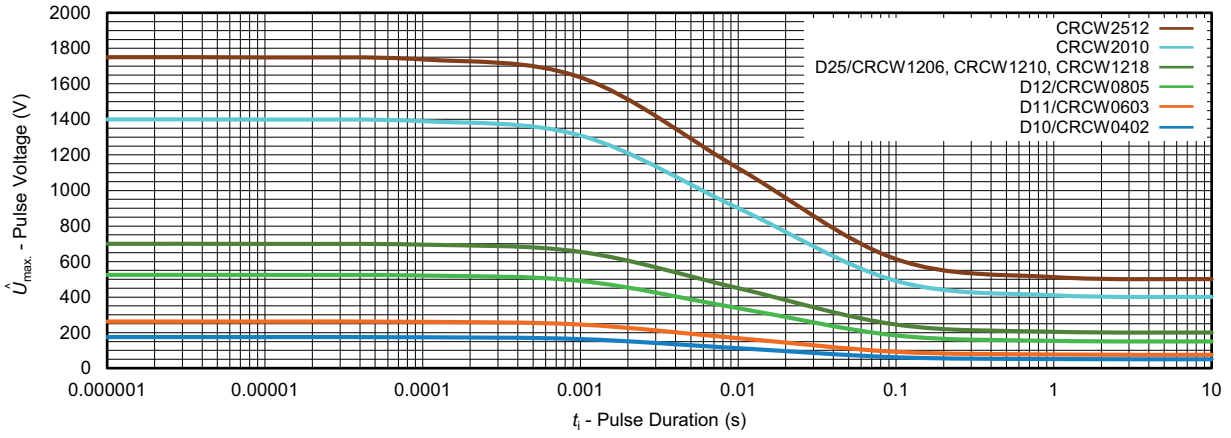
Maximum pulse load, single pulse; applicable if $\overline{P} \rightarrow 0$ and n < 1000 and $\hat{U} = \hat{U}_{max.}$;
for permissible resistance change equivalent to 8000 h operation

Continuous Pulse



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

Pulse Voltage



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

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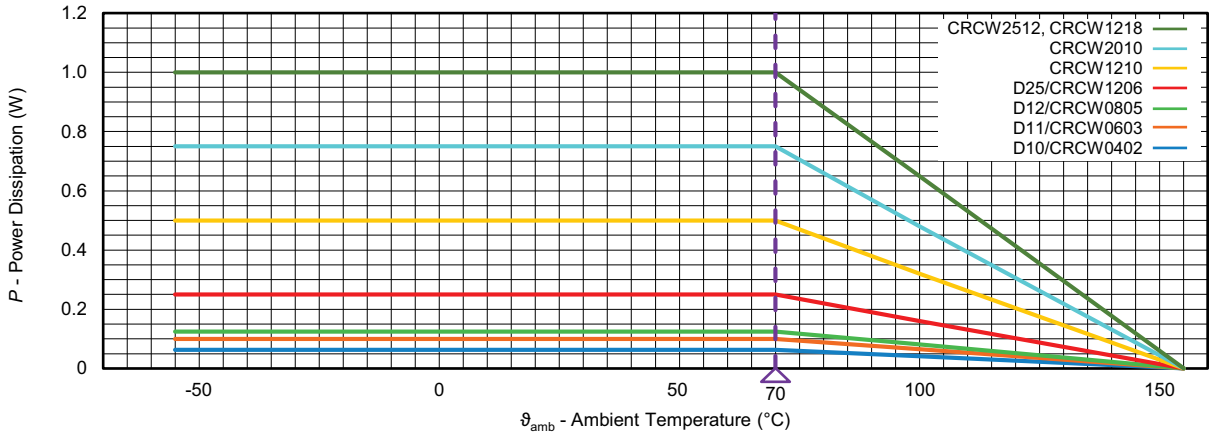
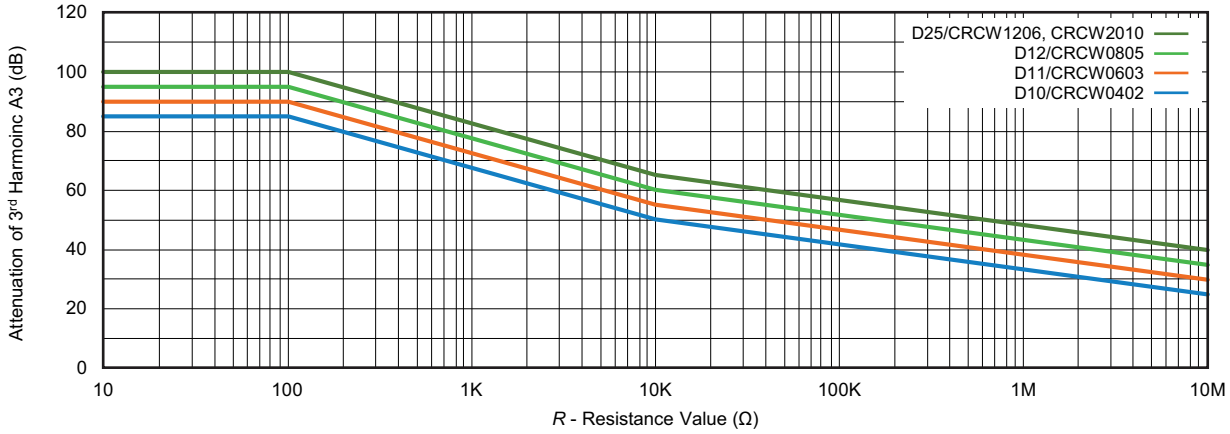
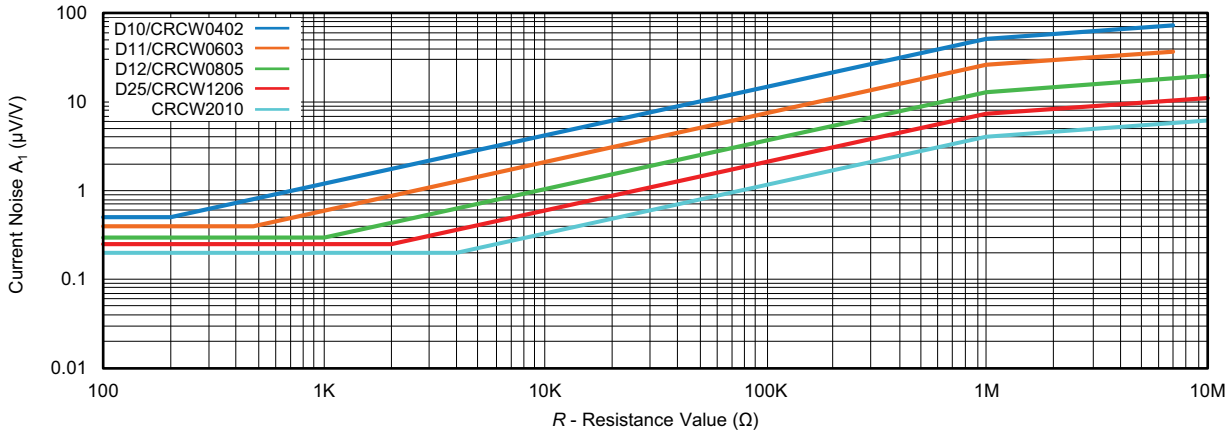
Derating



Non-Linearity



Current Noise



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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, 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 CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER
			Stability for product types: D/CRCW	1 Ω to 10 MΩ	
6.1	-	Measurements of resistance and tolerance	-	± 1 %	± 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	$U = \sqrt{P_{70} \times R} \leq U_{max.}$ 1.5 h on; 0.5 h off 70 °C; 1000 h 70 °C; 8000 h	 ± (1 % R + 0.05 Ω) ± (2 % R + 0.1 Ω)	 ± (2 % R + 0.1 Ω) ± (4 % R + 0.1 Ω)
7.3	-	Endurance at maximum temperature	155 °C; 1000 h	± (1 % R + 0.05 Ω)	± (2 % R + 0.1 Ω)
10.4	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (1 % R + 0.05 Ω)	
10.5	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	± (1 % R + 0.05 Ω)	± (2 % R + 0.1 Ω)
10.3	-	Climatic sequence:		± (1 % R + 0.05 Ω)	± (2 % R + 0.1 Ω)
10.3.4.2	2 (Ba)	Dry heat	125 °C; 16 h		
10.3.4.3	30 (Db)	Damp heat, cyclic	55 °C; 24 h; ≥ 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 ± 10) °C		
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	± (0.25 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)
10.1	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	
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	± (2 % R + 0.05 Ω)	
8.2	-	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) no visible damage	

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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	
			D/CRCW		
8.4	-	Periodic electric overload	$U = \sqrt{15 \times P_{70} \times R}$ or ≤ 2 x $U_{max.}$; whichever is the less severe; 0.1 s on; 2.5 s off; 1000 cycles	± (1 % R + 0.05 Ω) no visible damage	
8.5	-	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)	
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	± (0.25 % R + 0.05 Ω) no visible damage	± (0.5 % R + 0.05 Ω) no visible damage
11.1	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; (3 ± 0.3) s		
11.2	58 (Td)	Resistance to soldering heat	Soldering bath method; (260 ± 5) °C; (10 ± 1) s	± (0.25 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)
11.3	45 (XA)	Component solvent resistance	Isopropyl alcohol; +50 °C; method 2	No visible damage	
9.7	21 (Ue_3)	Shear (adhesion)	D11/CRCW0603 and smaller: 9 N D12/CRCW0805 to CRCW2512: 45 N	No visible damage	
9.8	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	
12.2	-	Voltage proof	U = 1.4 x 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	

Note

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

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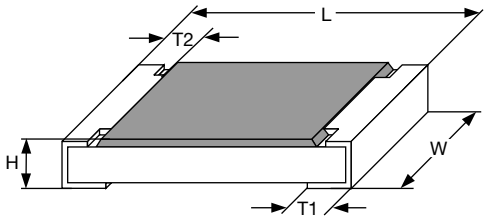
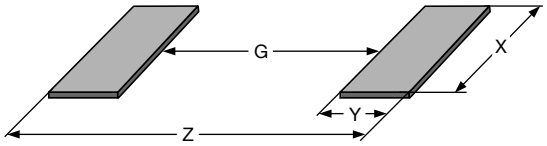
DIMENSIONS



DIMENSIONS AND MASS						
TYPE / SIZE	L (mm)	W (mm)	H (mm)	T1 (mm)	T2 (mm)	MASS (mg)
D10/CRCW0402	1.0 ± 0.05	0.5 ± 0.05	0.35 ± 0.05	0.25 ± 0.10	0.2 ± 0.10	0.65
D11/CRCW0603	1.55 + 0.10 / - 0.05	0.85 ± 0.10	0.45 ± 0.05	0.3 ± 0.20	0.3 ± 0.20	2
D12/CRCW0805	2.0 + 0.20 / - 0.10	1.25 ± 0.15	0.5 ± 0.10	0.3 + 0.20 / - 0.10	0.3 ± 0.20	5.5
D25/CRCW1206	3.2 + 0.10 / - 0.20	1.6 ± 0.15	0.55 ± 0.05	0.45 ± 0.20	0.4 ± 0.20	10
CRCW1210	3.2 ± 0.20	2.5 ± 0.20	0.55 ± 0.05	0.45 ± 0.20	0.4 ± 0.20	16
CRCW1218	3.2 + 0.10 / - 0.20	4.6 ± 0.15	0.55 ± 0.05	0.45 ± 0.20	0.4 ± 0.20	29.5
CRCW2010	5.0 ± 0.15	2.5 ± 0.15	0.6 ± 0.10	0.6 ± 0.20	0.6 ± 0.20	25.5
CRCW2512	6.3 ± 0.20	3.15 ± 0.15	0.6 ± 0.10	0.6 ± 0.20	0.6 ± 0.20	40.5

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)
D10/CRCW0402	-	-	-	-	0.45	0.60	0.60	1.65
D11/CRCW0603	0.65	1.10	1.25	2.85	0.75	0.75	1.00	2.25
D12/CRCW0805	0.90	1.30	1.60	3.50	1.00	0.95	1.45	2.90
D25/CRCW1206	1.40	1.40	1.95	4.20	1.50	1.05	1.80	3.60
CRCW1210	1.80	1.45	2.95	4.70	1.70	1.10	2.80	3.90
CRCW1218	1.80	1.30	5.10	4.40	1.90	1.10	4.90	4.10
CRCW2010	3.40	1.65	2.85	6.70	3.50	1.45	2.80	6.40
CRCW2512	4.60	1.60	3.65	7.80	4.75	1.45	3.50	7.65

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

For technical questions, contact: thickfilmchip@vishay.com
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