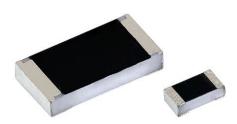


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# **High Resistance Value Thick Film Chip Resistors**



## **LINKS TO ADDITIONAL RESOURCES**



The D/CRCW-HR chip resistor series is the perfect choice for applications which require high resistance value components. Typical applications include voltage dividers and hybrids.

#### **FEATURES**





 Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processing

Material categorization: for definitions of compliance please see <a href="https://www.vishay.com/doc?99912">www.vishay.com/doc?99912</a>

### **APPLICATIONS**

- Voltage dividers
- Hybrids

TECHNICAL SPECIFICATIONS					
DESCRIPTION	D11/CRCW0603-HR e3	D12/CRCW0805-HR e3	D25/CRCW1206-HR e3		
Imperial size	0603	0805	1206		
Metric size code	RR1608M	RR2012M	RR3216M		
Resistance range		11 M $\Omega$ to 470 M $\Omega$			
Resistance tolerance		± 5 %			
Temperature coefficient		± 500 ppm/K			
Rated dissipation, P <sub>70</sub> <sup>(1)</sup>	0.1 W	0.125 W	0.25 W		
Operating voltage, U <sub>max.</sub> AC <sub>RMS</sub> /DC	75 V	150 V	200 V		
Voltage coefficient (2)		< 100M: < -0.1 ppm/V > 100M: < -0.3 ppm/V			
Permissible film temperature, $\vartheta_{\text{F max.}}^{(1)}$	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 %			
8000 h	≤ 4 %				
Permissible voltage against ambient (insulation):					
1 min, <i>U</i> <sub>ins</sub>	100 V	200 V	300 V		
Failure rate: FIT <sub>observed</sub>	≤ 0.1 x 10 <sup>-9</sup> /h				

#### **Notes**

- (1) Please refer to APPLICATION INFORMATION below
- (2) Voltage coefficient was tested according to 10 V measurements

## **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.

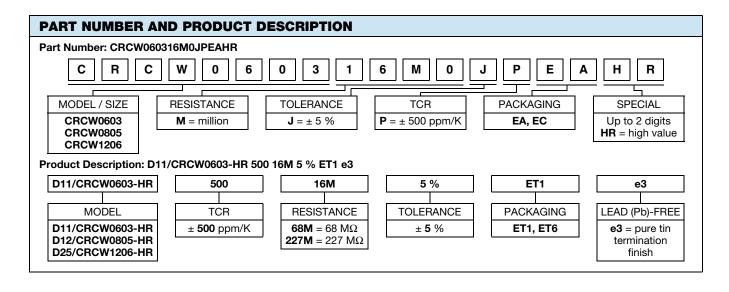


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TEMPERATURE COEFFICIENT AND RESISTANCE RANGE							
TYPE / SIZE TCR TOLERANCE RESISTANCE E-SERIES							
D11/CRCW0603-HR e3	± 500 ppm/K	± 5	11 M $\Omega$ to 470 M $\Omega$	E24			
D12/CRCW0805-HR e3	± 500 ppm/K	± 5	11 M $\Omega$ to 470 M $\Omega$	E24			
D25/CRCW1206-HR e3	± 500 ppm/K	± 5	11 MΩ to 470 MΩ	E24			

PACKAGING							
TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS	
D11/CRCW0603-HR e3	EA = ET1	5000		8 mm	4 mm	180 mm / 7"	
	EC = ET6	20 000				330 mm / 13"	
D12/CRCW0805-HR e3	EA = ET1	5000	Paper tape according to	8 mm	4 mm	180 mm / 7"	
	EC = ET6	20 000	IEC 60286-3, Type 1a			330 mm / 13"	
D25/CRCW1206-HR e3	EA = ET1	5000	. ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	0	4	180 mm / 7"	
	EC = ET6	20 000		8 mm	4 mm	330 mm / 13"	



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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 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** (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** <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 (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 <a href="https://www.vishav.com/how/leadfree">www.vishav.com/how/leadfree</a>.

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 <a href="https://www.vishay.com/doc?49037">www.vishay.com/doc?49037</a>.

#### **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 more information about high voltage products, please refer to RCV e3 datasheet "High Voltage (Up to 2 kV) Thick Film Chip Resistors" (<a href="https://www.vishav.com/doc?20054">www.vishav.com/doc?20054</a>).

The D/CRCW-HR with SnPb termination plating is designed for applications where lead bearing terminations are mandatory. For ordering D/CRCW-HR with SnPb terminations please refer to latest edition of datasheet D/CRCW-HR (www.vishay.com/doc?20011).

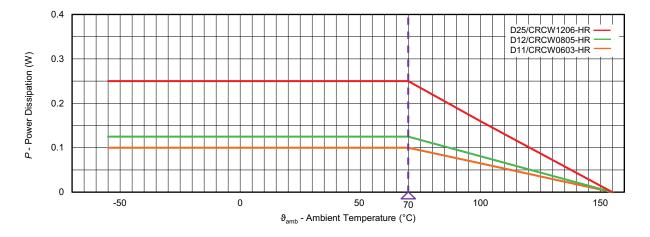
#### **Notes**

- (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 <a href="http://std.iec.ch/iec62474">http://std.iec.ch/iec62474</a>
- (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



## **FUNCTIONAL PERFORMANCE**

## **Derating**



#### **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.

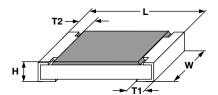


TEST PROCEDURES AND REQUIREMENTS							
EN IEC 60068-2 (1) 60115-1 TEST	IEC 60068-2 <sup>(1)</sup>		PROCEDURE	REQUIREMENTS PERMISSIBLI CHANGE (△ <i>R</i> )			
	TEST		STABILITY CLASS 2 OR BETTER				
CLAUSE	METHOD		Stability for product types:	11 M $\Omega$ to 470 M $\Omega$			
			D/CRCW-HR e3	1 1 10122 to 470 10122			
4.5	-	Resistance	-	± 5 %			
4.8	-	Temperature coefficient	At (20 / -55 / 20) °C and (20 / 125 / 20) °C	± 500 ppm/K			
4.05.1		Fadaman at 70 °C	$U = \sqrt{P_{70} \times R} \le U_{\text{max.}};$ 1.5 h on; 0.5 h off;				
4.25.1	-	Endurance at 70 °C	70 °C; 1000 h	$\pm$ (2 % $R$ + 0.1 $\Omega$ )			
			70 °C; 8000 h	$\pm$ (4 % $R$ + 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 ± 2) °C; (93 ± 3) % RH; 56 days	$\pm$ (2 % $R$ + 0.1 $\Omega$ )			
4.23	-	Climatic sequence:	-				
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	± (2 % R + 0.1 Ω)			
4.23.5	13 (M)	Low air pressure	8.5 kPa; 2 h; (25 ± 10) °C	1 (2 /071 1 0.1 32)			
4.23.6	30 (Db)	Damp heat, cyclic	55 °C; 5 days; > 90 % RH; 5 cycles				
4.23.7	-	DC load	$U = \sqrt{P_{70} \times R} \le U_{\text{max.}}; 1 \text{ min}$				
4.19	14 (Na)	Rapid change of temperature	30 min. at -55 °C and 30 min. at 125 °C; 1000 cycles	$\pm (1 \% R + 0.05 \Omega)$			
4.13	-	Short time overload	$U = 2.5 \text{ x} \sqrt{P_{70} \text{ x } R} \le 2 \text{ x } U_{\text{max.}};$ whichever is the less severe; 5 s	$\pm (2 \% R + 0.05 \Omega)$			
			Solder bath method, Sn60Pb40 non-activated flux; $(235 \pm 5)$ °C; $(2 \pm 0.2)$ s	Good tinning (≥ 95 % covered);			
4.17 58 (Td)	Solderability	Solder bath method; Sn96.5Ag3Cu0.5 or Sn99.3Cu0.7 non-activated flux; (245 ± 5) °C or (250 ± 5) °C (3 ± 0.3) s	no visible damage				
4.18	58 (Td)	Resistance to soldering heat	Solder bath method (260 $\pm$ 5) °C; (10 $\pm$ 1) s	$\pm (0.5 \% R + 0.05 \Omega)$			
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)	D11/CRCW0603-HR: 9 D12/CRCW0805-HR and D25/CRCW1206-HR: 45 N	No visible damage			
4.33	21 (Uu <sub>1</sub> )	Substrate bending	Depth 2 mm; 3 times	No visible damage, no open circuit in bent position $\pm (0.25 \% R + 0.05 \Omega)$			

#### Note

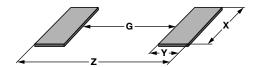
<sup>(1)</sup> The quoted IEC standards are also released as EN standards with the same number and identical contents

## **DIMENSIONS**



DIMENSIONS AND MASS								
TYPE / SIZE	L (mm)	W (mm)	H (mm)	T1 (mm)	T2 (mm)	MASS (mg)		
D11/CRCW0603-HR e3	1.55 + 0.10 / - 0.05	0.85 ± 0.1	$0.45 \pm 0.05$	$0.3 \pm 0.20$	$0.3 \pm 0.20$	2		
D12/CRCW0805-HR e3	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-HR 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								
	WAVE SOLDERING				REFLOW SOLDERING			
TYPE / SIZE	G (mm)	Y (mm)	X (mm)	Z (mm)	G Y X (mm) (mm)			Z (mm)
D11/CRCW0603-HR e3	0.65	1.10	1.25	2.85	0.75	0.75	1.00	2.25
D12/CRCW0805-HR e3	0.90	1.30	1.60	3.50	1.00	0.95	1.45	2.90
D25/CRCW1206-HR 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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