

## Automotive Ethernet Common Mode Termination Carbon Film Mini-MELF Resistors



CMA 0204 for ethernet termination with advanced pulse load capability are the perfect choice for automotive ethernet common mode termination resistors with high requirements on ESD pulse load capability.

### FEATURES

- Special carbon film technology
- Current noise ratio:  $\leq 0.05 \mu\text{V/V}$
- ESD capability: 8 kV contact, IEC 61000-4-2
- AEC-Q200 qualified
- Intrinsic sulfur resistance
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

AUTOMOTIVE  
GRADE

RoHS  
COMPLIANT

HALOGEN  
FREE

GREEN  
(5-2008)

### APPLICATIONS

- Automotive

TECHNICAL SPECIFICATIONS	
DESCRIPTION	CMA 0204
DIN size	0204
Metric size code	RC3715M
Resistance range	500 $\Omega$ ; 1 k $\Omega$ ; 2 k $\Omega$
Resistance tolerance	$\pm 0.5 \%$ ; $\pm 1 \%$
Temperature coefficient (typical)	-250 ppm/K
Rated dissipation, $P_{70}$ <sup>(1)</sup>	0.4 W
Operating voltage, $U_{\text{max}}$ , AC <sub>RMS</sub> /DC	$\sqrt{P_{70} \times R}$
Permissible film temperature, $\vartheta_{F \text{ max}}$ <sup>(1)</sup>	155 °C
Operating temperature range <sup>(1)</sup>	-55 °C to 155 °C
Permissible voltage against ambient (insulation): 1 min; $U_{\text{ins}}$	300 V
Internal thermal resistance <sup>(1)</sup>	46 K/W
Failure rate: FIT <sub>observed</sub>	$\leq 0.05 \times 10^{-9}/\text{h}$

#### Note

<sup>(1)</sup> 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.

Please consider the application note “Thermal Management in Surface-Mounted Resistor Applications” ([www.vishay.com/doc?28844](http://www.vishay.com/doc?28844)) for information on the general nature of thermal resistance.

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.

**MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION**

OPERATION MODE		POWER
Rated dissipation, $P_{70}$	CMA 0204	0.4 W
Operating temperature range		-55 °C to 155 °C
Permissible film temperature, $\vartheta_F$ max.		155 °C
Max. resistance change at $P_{70}$ for resistance range, $ \Delta R/R $ after:	CMA 0204	500 $\Omega$ ; 1 k $\Omega$ ; 2 k $\Omega$
	1000 h	$\leq 1 \%$
	8000 h	$\leq 2 \%$

**TEMPERATURE COEFFICIENT AND RESISTANCE RANGE**

TYPE / SIZE	TCR (TYPICAL)	TOLERANCE	RESISTANCE	E-SERIES
CMA 0204	-250 ppm/K	$\pm 0.5 \%$	500 $\Omega$ ; 1 k $\Omega$ ; 2 k $\Omega$	n/a
		$\pm 1 \%$	1 k $\Omega$	

**PACKAGING**

TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS
CMA 0204	B3 = BL	3000	Antistatic blister tape acc. IEC 60286-3 Type 2a	8 mm	4 mm	$\varnothing$ 180 mm / 7"
	B0	10 000				$\varnothing$ 330 mm / 13"

**PART NUMBER AND PRODUCT DESCRIPTION**

Part Number: CMA02040X1001FB300

C	M	A	0	2	0	4	0	X	1	0	0	1	F	B	3	0	0
TYPE / SIZE			VERSION			TCR			RESISTANCE			TOLERANCE			PACKAGING		
CMA0204			0 = neutral			X = no indication			3 digit value 1 digit multiplier Multiplier 0 = *10 <sup>0</sup> 1 = *10 <sup>1</sup>			F = ± 1 % D = ± 0.5%			B3 B0		

Product Description: CMA 0204 1 % BL 1K0

CMA	0204	1 %	BL	1K0
TYPE	SIZE	TOLERANCE	PACKAGING	RESISTANCE
CMA	0204	$\pm 0.5 \%$ $\pm 1 \%$	BL B0	500R = 500 $\Omega$ 1K0 = 1 k $\Omega$ 2K0 = 2 k $\Omega$

**Note**

- Products can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION



## DESCRIPTION

Production of the CMA 0204 specialty MELF resistors for automotive ethernet common mode termination is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous and dense carbon film is deposited on a high grade ceramic body (85 %  $\text{Al}_2\text{O}_3$ ). Nickel plated steel termination caps are firmly pressed on the coated rods. A special laser is used to achieve the target value by smoothly cutting a helical groove in the resistive layer without damaging the ceramics. The resistors are covered by protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure matte tin on nickel plating. Four color code rings designate the resistance value and tolerance in accordance with **IEC 60062** <sup>(1)</sup>.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. This includes full screening for the elimination of products with a potential risk of early life failures according to EN 140401-803, 2.1.2.2. Only accepted products are laid directly into the blister tape in accordance with **IEC 60286-3, Type 2a** <sup>(1)</sup>.

## 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 completely lead (Pb)-free, 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, however, excellent solderability is proven after extended storage in excess of 10 years. 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 <sup>(2)</sup>
- The Global Automotive Declarable Substance List (GADSL) <sup>(3)</sup>
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) <sup>(4)</sup> 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](http://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](http://www.vishay.com/doc?49037).

## APPROVALS

Where applicable the resistors are tested in accordance with **EN 140 401-803** which refers to **EN 60115-1**, **EN 60115-8** and the variety of environmental test procedures of the **IEC 60068** <sup>(1)</sup> series.

Vishay Beyschlag has achieved “**Approval of Manufacturer**” in accordance with **IECQ 03-1**. The release certificate for “**Technology Approval Schedule**” in accordance with **CECC 240001** based on **IECQ 03-3-1** is granted for the Vishay Beyschlag manufacturing process.

The resistors are qualified according to AEC-Q200.

## RELATED PRODUCTS

- “High Pulse Load Carbon Film MELF Resistors” ([www.vishay.com/doc?28956](http://www.vishay.com/doc?28956))

## Notes

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

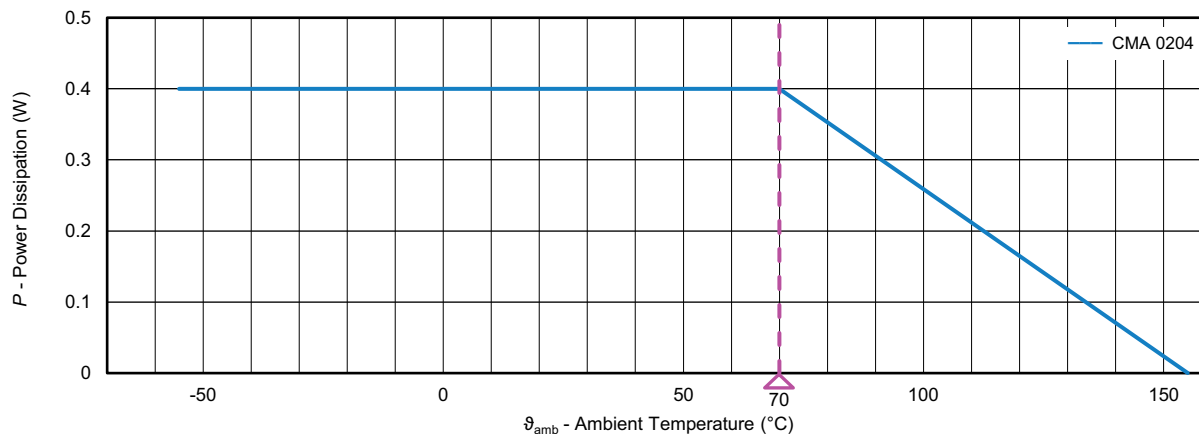
<sup>(2)</sup> The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at <http://std.iec.ch/iec62474>

<sup>(3)</sup> The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at [www.gadsl.org](http://www.gadsl.org)

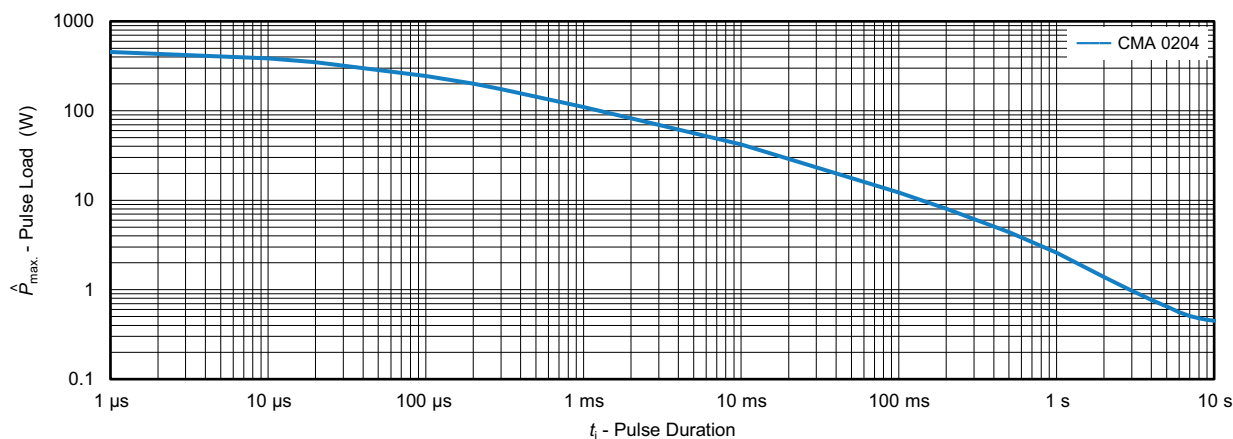
<sup>(4)</sup> The SVHC list is maintained by the European Chemical Agency (ECHA) and available at <http://echa.europa.eu/candidate-list-table>



## FUNCTIONAL PERFORMANCE

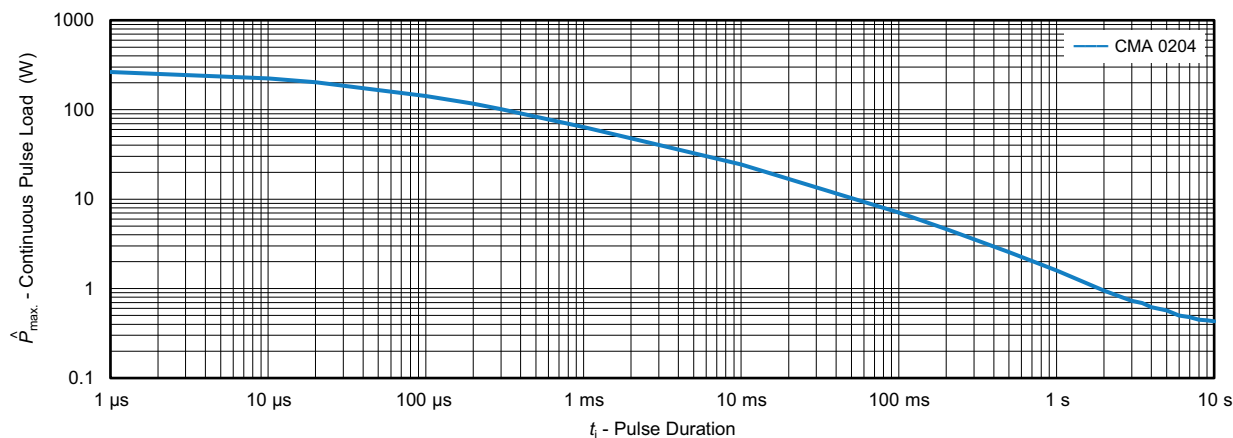


## Derating



Maximum pulse load, single pulse; applicable if  $\bar{P} \rightarrow 0$  and  $n \leq 1000$  and  $\hat{U} \leq 2$  kV;  
for permissible resistance change  $\pm (0.5 \% R + 0.05 \Omega)$

## Single Pulse



Maximum pulse load, continuous pulse; applicable if  $\bar{P} \leq P(\vartheta_{amb})$  and  $\hat{U} \leq 2$  kV;  
for permissible resistance change  $\pm (0.5 \% R + 0.05 \Omega)$

## Continuous Pulse

**TESTS AND REQUIREMENTS**

All tests are carried out in accordance with the following specifications:

EN 60115-1, generic specification

EN 60115-8, sectional specification

EN 140401-803, 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 140401-803. 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/ECA-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 printed circuit boards in accordance with EN 60115-8, 2.4.2, unless otherwise specified.

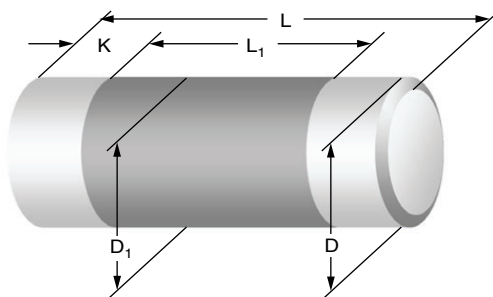
TEST PROCEDURES AND REQUIREMENTS				
EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R$ )
			<b>Stability for product types:</b>	
			<b>CMA 0204</b>	500 $\Omega$ ; 1 k $\Omega$ ; 2 k $\Omega$
4.5	-	Resistance	-	$\pm 1 \% R$ ; $\pm 0.5 \% R$
4.8	-	Temperature coefficient (typ.)	At (20 / -55 / 20) °C and (20 / 125 / 20) °C	-250 ppm/K
4.25.1	-	Endurance at 70 °C:	$U = \sqrt{P_{70} \times R} \leq U_{\max.}$ ; whichever is the less severe; 1.5 h on; 0.5 h off;  70 °C; 1000 h 70 °C; 8000 h	$\pm (1 \% R + 0.05 \Omega)$ $\pm (2 \% R + 0.05 \Omega)$
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h 155 °C; 1000 h	$\pm (2 \% R + 0.05 \Omega)$ $\pm (4 \% R + 0.05 \Omega)$
4.24	78 (Cab)	Damp heat, steady state	(40 $\pm$ 2) °C; 56 days; (93 $\pm$ 3) % RH	$\pm (1 \% R + 0.1 \Omega)$
4.37	67 (Cy)	Damp heat, steady state, accelerated	(85 $\pm$ 2) °C (85 $\pm$ 5) % RH $U = \sqrt{0.3 \times P_{70} \times R} \leq 100 \text{ V}$ and $U = 0.3 \times U_{\max.}$ ; (the smaller value is valid) 1000 h	$\pm (2 \% R + 0.1 \Omega)$
4.23 4.23.2 4.23.3 4.23.4 4.23.5 4.23.6 4.23.7	2 (Bb) 30 (Db) 1 (Ab) 13 (M) 30 (Db) -	Climatic sequence: dry heat damp heat, cyclic cold low air pressure damp heat, cyclic DC load	UCT; 16 h  55 °C; 24 h; $\geq 90 \% \text{ RH}$ ; 1 cycle  LCT; 2 h  8.5 kPa; 2 h; (25 $\pm$ 10) °C  55 °C; 24 h; $\geq 90 \% \text{ RH}$ ; 5 cycles  $U = \sqrt{P_{70} \times R} \leq U_{\max.}$ ; 1 min LCT = -55 °C; UCT = 155 °C	$\pm (1 \% R + 0.1 \Omega)$
-	1 (Aa)	Cold	-55 °C; 2 h	$\pm (0.5 \% R + 0.1 \Omega)$

TEST PROCEDURES AND REQUIREMENTS				
EN 60115-1 CLAUSE	IEC 60068-2 <sup>(1)</sup> TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R$ )
			Stability for product types:	
			<b>CMA 0204</b>	500 $\Omega$ ; 1 k $\Omega$ ; 2 k $\Omega$
4.19	14 (Na)	Rapid change of temperature	30 min at LCT; 30 min at UCT; LCT = -55 °C; UCT = 125 °C 5 cycles 1000 cycles	$\pm (0.5 \% R + 0.1 \Omega)$ $\pm (1.5 \% R + 0.1 \Omega)$
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	$\pm (0.5 \% R + 0.1 \Omega)$
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 2000 Hz; no resonance; amplitude $\leq 1.5$ mm or $\leq 200$ m/s <sup>2</sup> ; 7.5 h	$\pm (0.25 \% R + 0.1 \Omega)$
4.38	-	Electrostatic discharge (human body model)	IEC 61340-3-1 <sup>(1)</sup> ; 3 pos. + 3 neg. 6 kV (equivalent to MIL-STD-883, method 3015)	$\pm (0.05 \% R + 0.05 \Omega)$
4.17	58 (Td)	Solderability	Solder bath method; SnPb40; non-activated flux; (215 $\pm$ 3) °C; (3 $\pm$ 0.3) s	Good tinning ( $\geq 95$ % covered); no visible damage
			Solder bath method; SnAg3Cu0.5 or SnAg3.5; non-activated flux; (235 $\pm$ 3) °C; (2 $\pm$ 0.2) s	Good tinning ( $\geq 95$ % covered); no visible damage
4.18	58 (Td)	Resistance to soldering heat	Solder bath method; (260 $\pm$ 5) °C; (10 $\pm$ 1) s	$\pm (0.5 \% R + 0.1 \Omega)$
			Reflow method 2 (IR / forced gas convection); (260 $\pm$ 5) °C; (10 $\pm$ 1) s	$\pm (0.25 \% R + 0.1 \Omega)$
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol; 50 °C; method 2	No visible damage
4.30	45 (XA)	Solvent resistance of marking	Isopropyl alcohol; 50 °C; method 1, toothbrush	Marking legible; no visible damage
4.32	21 (Ue <sub>3</sub> )	Shear (adhesion)	45 N	No visible damage
4.33	21 (Ue <sub>1</sub> )	Substrate bending	Depth 2 mm, 3 times	No visible damage; no open circuit in bent position $\pm (0.25 \% R + 0.1 \Omega)$
4.7	-	Voltage proof	$U_{RMS} = U_{ins.}$ ; 60 s	No flashover or breakdown
4.35	-	Flammability	IEC 60695-11-5 <sup>(1)</sup> ; needle flame test; 10 s	No burning after 30 s

## 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)	D (mm)	L <sub>1</sub> min. (mm)	D <sub>1</sub> (mm)	K (mm)	MASS (mg)
CMA 0204	3.6 + 0/- 0.2	1.4 + 0/- 0.1	1.8	D + 0/- 0.15	0.75 ± 0.1	19

### Notes

- Color code marking is applied according to IEC 60062 <sup>(1)</sup> in four bands. Each color band appears as a single solid line, voids are permissible if at least 2/3 of the band is visible from each radial angle of view. The last color band for tolerance is approximately 50 % wider than the other bands. An interrupted brown band between the 2<sup>nd</sup> and 3<sup>rd</sup> full band identifies the special carbon film

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

## SOLDERING RECOMMENDATIONS

For recommended solder pad dimensions please refer to [www.vishay.com/doc?28950](http://www.vishay.com/doc?28950).

For recommended soldering profiles please refer to [www.vishay.com/doc?31090](http://www.vishay.com/doc?31090).



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