

High Pulse Load MELF Resistors



CMA 0204 specialty MELF resistors with advanced pulse load capability are the perfect choice for the protection of circuitry with signal or mains input lines from surge pulses. The resistors are also suitable for circuits exposed to high levels of electromagnetic interference or electrostatic discharge. The applications are in all fields of automotive, telecommunication, industrial and medical equipment.

FEATURES

- Special carbon film technology
- Up to 4 kV single pulse capability
- Up to 70 W continuous pulse load
- ESD capability: 6 kV, human body model
- Compatible with lead (Pb)-free and lead containing soldering processes
- Compliant to RoHS directive 2002/95/EC



RoHS
COMPLIANT
GREEN
(5-2009)**

APPLICATIONS

- Automotive
- Telecommunication
- Industrial
- Medical equipment

METRIC SIZES

| | |
|------|----------|
| DIN | 0204 |
| CECC | RC 3715M |

TECHNICAL SPECIFICATIONS

| DESCRIPTION | CMA 0204 | | |
|--|-------------------------------|------------------|------------|
| Metric CECC size | RC 3715M | | |
| Resistance range | 10 Ω to 100 k Ω | | |
| Resistance tolerance | $\pm 2\%$ | | |
| Temperature coefficient | See TCR graph | | |
| Operation mode | Standard | Power | |
| Climatic category (LCT/UCT/days) | 55/125/56 | 55/155/56 | |
| Rated dissipation, P_{70} ⁽¹⁾ | 0.25 W | 0.4 W | |
| Operating voltage, U_{max} . AC/DC | 200 V | | |
| Film temperature ⁽²⁾ | 125 $^{\circ}$ C | 155 $^{\circ}$ C | |
| Max. resistance change at P_{70} for resistance range, $\Delta R/R$ after: | 10 Ω to 100 k Ω | | |
| | 1000 h | $\leq 1\%$ | $\leq 2\%$ |
| | 8000 h | $\leq 2\%$ | $\leq 4\%$ |
| Permissible voltage against ambient (insulation): | 1 min; U_{ins} | 300 V | |
| | Continuous | 75 V | |
| Failure rate: FIT _{observed} | $\leq 0.1 \times 10^{-9}/h$ | | |

Notes

- 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.

⁽¹⁾ The power dissipation on the resistor generates a temperature rise against the local ambient, depending on the heatflow support of the printed-circuit board (thermal resistance). 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.

⁽²⁾ Film temperatures above the specified range may be permissible, e.g. 175 $^{\circ}$ C. Please contact the factory for details.

** Please see document "Vishay Material Category Policy": www.vishay.com/doc?99902

DIMENSIONS



| DIMENSIONS AND MASS | | | | | | |
|---------------------|---------------|---------------|--------------------------|---------------------|-----------|-----------|
| TYPE | L (mm) | D (mm) | L ₁ min. (mm) | D ₁ (mm) | K (mm) | MASS (mg) |
| CMA 0204 | 3.6 + 0/- 0.2 | 1.4 + 0/- 0.1 | 1.8 | D + 0/- 0.15 | 0.8 ± 0.1 | 19 |

Note

- Color code marking is applied according to IEC 60062 ⁽³⁾ in four bands (E24 series). 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 band between the 2nd and 3rd full band identifies the special carbon film.

PATTERN STYLES FOR MELF RESISTORS



| RECOMMENDED SOLDER PAD DIMENSIONS | | | | | | | | |
|-----------------------------------|----------------|--------|--------|--------|------------------|--------|--------|--------|
| TYPE | WAVE SOLDERING | | | | REFLOW SOLDERING | | | |
| | G (mm) | Y (mm) | X (mm) | Z (mm) | G (mm) | Y (mm) | X (mm) | Z (mm) |
| CMA 0204 | 1.5 | 1.5 | 1.8 | 4.5 | 1.7 | 1.2 | 1.6 | 4.1 |

Note

- 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, however, they will be found adequate for most general applications.



| PART NUMBER AND PRODUCT DESCRIPTION | | | | | | | | | | | | | | | | | |
|--|-------------------|---|-------------------|---|---|---|------------------------------|-----------|-----------|---|---------------------------------|---|---|---|---|---|---|
| Part Number: CMA02040X4701GB300 | | | | | | | | | | | | | | | | | |
| C | M | A | 0 | 2 | 0 | 4 | 0 | X | 4 | 7 | 0 | 1 | G | B | 3 | 0 | 0 |
| MODEL/SIZE | SPECIAL CHARACTER | | TCR | | VALUE | | | TOLERANCE | PACKAGING | | SPECIAL | | | | | | |
| CMA0204 | 0 = Neutral | | X = No indication | | 3 digit value 1 digit multiplier Multiplier 9 = *10 ⁻¹ 0 = *10 ⁰ 1 = *10 ¹ 2 = *10 ² 3 = *10 ³ | | | G = ± 2 % | B3 B0 | | Up to 2 digits 00 = Standard | | | | | | |
| Product Description: CMA 0204 2 % BL 4K7 | | | | | | | | | | | | | | | | | |
| CMA | 0204 | | 2 % | | BL | | 4K7 | | | | | | | | | | |
| MODEL | SIZE | | TOLERANCE | | PACKAGING | | RESISTANCE VALUE | | | | | | | | | | |
| CMA | 0204 | | ± 2 % | | BL B0 | | 100R = 100 Ω 4K7 = 4.7 kΩ | | | | | | | | | | |

Note

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

| PACKAGING | | | |
|-----------|--|-------------|---------|
| MODEL | BLISTER TAPE ON REEL ACC. IEC 60286-3 | | |
| | DIAMETER | PIECES/REEL | CODE |
| CMA 0204 | 180 mm/7" | 3000 | B3 = BL |
| | 330 mm/13" | 10 000 | B0 |

DESCRIPTION

Production of the CMA 0204 specialty MELF resistors with advanced pulse load capability 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 % Al₂O₃). 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 tin on nickel plating. Four color code rings designate the resistance value and tolerance in accordance with **IEC 60 062** ⁽³⁾.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are laid directly into the blister tape in accordance with **IEC 60 286-3** ⁽³⁾.

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase as shown in **IEC 61760-1** ⁽³⁾. Excellent solderability is proven, even after extended storage in excess of 10 years. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free soldering processes. The immunity of the plating against tin whisker growth has been proven under extensive testing.

All products comply with the **GADSL** ⁽¹⁾ and the **CEFIC-EECA-EICTA** ⁽²⁾ list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

- 2000/53/EC End of Vehicle life Directive (ELV) and Annex II (ELV II)
- 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

Notes

⁽¹⁾ Global Automotive Declarable Substance List, see www.gadsl.org.

⁽²⁾ CEFIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organisation representing the information and communications technology and consumer electronics), see www.eicta.org/index.php?id=995
→ issues → environment policy → chemicals → chemicals for electronics.

⁽³⁾ The quoted IEC standards are also released as EN standards with the same number and identical contents.

FUNCTIONAL PERFORMANCE



Derating - Standard Operation



Derating - Standard Operation



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

FUNCTIONAL PERFORMANCE


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

Continuous Pulses


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

Pulse Voltage


Pulse load rating in accordance with IEC 60115-1, 4.27; 1,2 μ s/50 μ s; 5 pulses at 12 s intervals; for permissible resistance change 0.5 %

1.2/50 Pulse

FUNCTIONAL PERFORMANCE



Pulse load rating in accordance with IEC 60115-1, 4.27; 10 μ s/700 μ s; 10 pulses at 1 minute intervals; for permissible resistance change 0.5 %

10/700 Pulse



Temperature coefficient of resistance

Temperature Coefficient (TCR) (Typical Curve)



In accordance with IEC 60 195

Current Noise - A₁



TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the following specifications:

EN 60115-1, generic specification

EN 140400, sectional specification

EN 140401-803, detail specification

The Test Procedures and Requirements table contains the applicable tests selected from the documents listed above.

The tests are carried out in accordance with IEC 60068 (1) and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3 (1). Climatic category LCT/UCT/56 (rated temperature range: Lower category temperature,

upper category temperature; damp heat, long term, 56 days) is valid.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 45 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

The components are mounted for testing on printed-circuit boards in accordance with EN 140400, 2.3.3, unless otherwise specified.

The requirements stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-803.

| TEST PROCEDURES AND REQUIREMENTS | | | | |
|---|-----------------------------|--|--|--|
| EN 60115-1 CLAUSE | IEC 60068-2 (1) TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE (ΔR) |
| | | | Stability for product types: | |
| | | | CMA 0204 | 10 Ω to 100 k Ω |
| 4.5 | - | Resistance | - | $\pm 2 \% R$ |
| 4.8.4.2 | - | Temperature coefficient | At (20/- 55/20) °C and (20/125/20) °C | See Temperature Coefficient graph |
| 4.25.1 | - | Endurance at 70 °C: standard operation mode | $U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1.5 h on; 0.5 h off; 70 °C; 1000 h 70 °C; 8000 h | $\pm (1 \% R + 0.05 \Omega)$ $\pm (2 \% R + 0.05 \Omega)$ |
| 4.25.1 | - | Endurance at 70 °C: power operation mode | $U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1.5 h on; 0.5 h off; 70 °C; 1000 h 70 °C; 8000 h | $\pm (2 \% R + 0.05 \Omega)$ $\pm (4 \% R + 0.05 \Omega)$ |
| 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 | $\pm (1 \% R + 0.1 \Omega)$ |
| 4.23 | | Climatic sequence: | | |
| 4.23.2 | 2 (Ba) | dry heat | UCT; 16 h | |
| 4.23.3 | 30 (Db) | damp heat, cyclic | 55 °C; 24 h; $\geq 90 \% RH$; 1 cycle | |
| 4.23.4 | 1 (Aa) | cold | LCT; 2 h | |
| 4.23.5 | 13 (M) | low air pressure | 8.5 kPa; 2 h; (25 \pm 10) °C | |
| 4.23.6 | 30 (Db) | damp heat, cyclic | 55 °C; 24 h; $\geq 90 \% RH$; 5 cycles | |
| 4.23.7 | - | DC load | $U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1 min LCT = - 55 °C; UCT = 155 °C | $\pm (1 \% R + 0.1 \Omega)$ |
| - | 1 (Aa) | Cold | - 55 °C; 2 h | $\pm (0.5 \% R + 0.1 \Omega)$ |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 min at - 55 °C; 30 min at + 125 °C; 5 cycles | $\pm (0.5 \% R + 0.1 \Omega)$ |
| 4.13 | - | Short time overload; standard operation mode | $U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$; 5 s | $\pm (0.25 \% R + 0.1 \Omega)$ |
| | | Short time overload; power operation mode | $U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$; 5 s | $\pm (0.25 \% R + 0.1 \Omega)$ |
| 4.40 | - | Electrostatic discharge (human body model) | IEC 61340-3-1 (1); 3 pos. + 3 neg. discharges CMA 0204: 6 kV | $\pm (0.5 \% R + 50 m\Omega)$ |

| TEST PROCEDURES AND REQUIREMENTS | | | | |
|----------------------------------|-----------------------------|-------------------------------|--|--|
| EN 60115-1 CLAUSE | IEC 60068-2 (1) TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE (ΔR) |
| | | | Stability for product types: | |
| | | | CMA 0204 | 10 Ω to 100 k Ω |
| 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 |
| 4.17.2 | 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 |
| 4.18.2 | 58 (Td) | Resistance to soldering heat | Solder bath method ; (260 \pm 5) °C; (10 \pm 1) s | \pm (0.5 % R + 0.1 Ω) |
| 4.32 | 21 (Ue ₃) | Shear (adhesion) | 45 N | No visible damage |
| 4.7 | - | Voltage proof | $U_{RMS} = U_{ins}$; 60 s | No flashover or breakdown |
| 4.35 | - | Flammability | IEC 60 695-11-5 (1), needle flame test; 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.

HISTORICAL 12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see the 12NC table.
- The remaining 4 digits indicate the resistance value:
 - The first 3 digits indicate the resistance value.
 - The last digit indicates the resistance decade in accordance with the 12NC Indicating Resistance Decade table.

Last Digit of 12NC Indicating Resistance Decade

| RESISTANCE DECADE | LAST DIGIT |
|----------------------------------|------------|
| 10 Ω to 99.9 Ω | 9 |
| 100 Ω to 999 Ω | 1 |
| 1 k Ω to 9.99 k Ω | 2 |
| 10 k Ω to 99.9 k Ω | 3 |
| 100 k Ω to 999 k Ω | 4 |

Historical 12NC Example

The 12NC of a CMA 0204 resistor, value 47 k Ω with \pm 2 % tolerance, supplied in blister tape of 3000 units per reel is: 2312 159 24703.

| HISTORICAL 12NC - Resistor type and packaging | | | |
|---|-----------|---------------------------|--------------------|
| DESCRIPTION | | ORDERING CODE 2312 | |
| | | BLISTER TAPE ON REEL | |
| TYPE | TOL. | BL 3000 UNITS | B0 10 000 UNITS |
| CMA 0204 | \pm 2 % | 159 2.... | 149 2.... |



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Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:

moschip.ru

moschip.ru_4

moschip.ru_6

moschip.ru_9