# Axial Leaded Multilayer Ceramic Capacitors for Automotive Applications Class 1 and Class 2, 50 $V_{DC}$, 100 $V_{DC}$, 200 $V_{DC}$

## FEATURES

- AEC-Q200 qualified with PPAP available
- High reliability MLCC insert with wet build process
- High operating temperature up to 160 °C
- High capacitance with small size
- Axial mounting style
- Parts compliant with ELV Directive
- For fully RoHS-compliant alternative A...R Series, please refer to www.vishay.com/doc?45231
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

**Note**

* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details.

## APPLICATIONS

- Automotive

| QUICK REFERENCE DATA | | | | | | | |
|---|---|---|---|---|---|---|---|
| DESCRIPTION | VALUE | | | | | | |
| Ceramic Class | 1 | | | 2 | | | |
| Ceramic Dielectric | C0G | | | X7R | | | X8R |
| Voltage ($V_{DC}$) | 50 | 100 | 200 | 50 | 100 | 200 | 50 |
| Min. Capacitance (pF) | 100 | 100 | 100 | 470 | 470 | 330 | 470 |
| Max. Capacitance (pF) | 10 000 | 10 000 | 1000 | 1 000 000 | 470 000 | 68 000 | 330 000 |
| Mounting | Axial | | | | | | |

## MARKING

Marking indicates capacitance value and tolerance in accordance with “EIA 198” and voltage marks.

## OPERATING TEMPERATURE RANGE

-55 °C to +160 °C (50 % rated voltage above 150 °C)

## TEMPERATURE CHARACTERISTICS

Class 1: C0G

Class 2: X7R, X8R

## SECTIONAL SPECIFICATIONS

Climatic category (acc. to EN 60058-1)

Class 1 and 2: 55/125/21

## APPROVALS

EIA 198
IEC 60384-9
AEC-Q200

## DESIGN

- The capacitors consist of a high reliability MLCC
- The lead wires are 0.5 mm and are made of 100 % tinned copper clad steel wire
- Coating is made of yellow colored flame retardant epoxy resin in accordance with UL 94 V-0

## CAPACITANCE RANGE

100 pF to 1 µF

## TOLERANCE ON CAPACITANCE

± 5 %, ± 10 %, ± 20 %

## RATED VOLTAGE

50 $V_{DC}$, 100 $V_{DC}$, 200 $V_{DC}$

## TEST VOLTAGE

- 50 $V_{DC}$ and 100 $V_{DC}$: 250 % of rated voltage
- 200 $V_{DC}$: 200 % of rated voltage

## INSULATION RESISTANCE

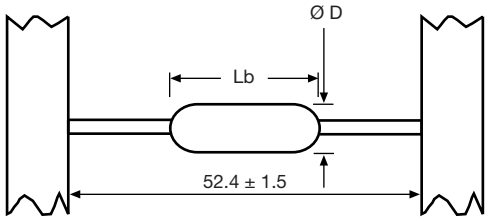
100 GΩ or 1000 ΩF whichever is less at rated voltage within 2 min of charging.

## DISSIPATION FACTOR

Class 1: 0.1 % max.
(at 1 MHz, 1 V where C ≤ 1000 pF;
at 1 kHz; 1 V where C > 1000 pF)

Class 2: 2.5 % max.
(at 1 kHz, 1 V)

## DIMENSIONS (in millimeters)

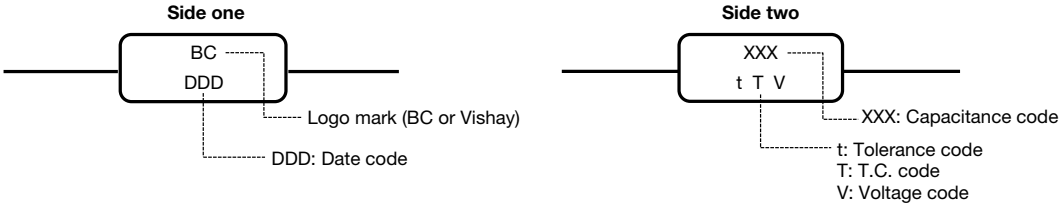



| SIZE CODE | $Lb_{MAX.}$ | $ØD_{MAX.}$ |
|---|---|---|
| 15 | 3.8 | 2.6 |
| 20 | 5.1 | 3.1 |

**Note**

- The leads are matte tinned FeCu wire.

## MARKING




**MARKING CODE DESCRIPTION**

| DDD | XXX | t | V | T |
|---|---|---|---|---|
| **Date Code** | **Capacitance Code** | **Tolerance Code** | **Voltage Code** | **T.C. Code** |
| The first digit is the year, the last two digits are the week. For example: 109 = 2011, 9th week 217 = 2012, 17th week | Two significant digits followed by one digit for the multiplier as given below. 1 = * 10, 2 = * 100, 3 = * 1000, 4 = * 10 000, 5 = * 100 000 | J = ± 5 % K = ± 10 % M = ± 20 % | 1 = 100 V 2 = 200 V 5 = 50 V | A = C0G (NP0) C = X7R R = X8R |

## ORDERING CODE INFORMATION

| A | 104 | K | 15 | X7R | F | 5 | TAA | V |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 3 4 | 5 | 6 7 | 8 9 10 | 11 | 12 | 13 14 15 | 16 |
| **Product Type** | **Capacitance (pF)** | **Capacitance Tolerance** | **Size Code** | **TC Code** | **Rated Voltage** | **Lead Diameter** | **Packaging** | **AEC-Q200 Qualified** |
| A = axial leaded MLCC | The first two digits are the significant figures of capacitance and the last digit is a multiplier as follows: 1 = * 10 2 = * 100 3 = * 1000 4 = * 10 000 5 = * 100 000 | J = ± 5 % K = ± 10 % M = ± 20 % | Please refer to relevant datasheet | Please refer to relevant datasheet | F = 50 $V_{DC}$ H = 100 $V_{DC}$ K = 200 $V_{DC}$ | 5 = 0.50 mm ± 0.05 mm | TAA = reel UAA = ammo | V = AEC-Q200 qualified |

## ORDERING CODES

| DIELECTRIC C0G | | | |
|---|---|---|---|
| CAP. (pF) | 50 $V_{DC}$ | 100 $V_{DC}$ | 200 $V_{DC}$ |
| 100 | A101#15C0GF5###V | A101#15C0GH5###V | A101#15C0GK5###V |
| 120 | A121#15C0GF5###V | A121#15C0GH5###V | A121#15C0GK5###V |
| 150 | A151#15C0GF5###V | A151#15C0GH5###V | A151#15C0GK5###V |
| 180 | A181#15C0GF5###V | A181#15C0GH5###V | A181#15C0GK5###V |
| 220 | A221#15C0GF5###V | A221#15C0GH5###V | A221#15C0GK5###V |
| 270 | A271#15C0GF5###V | A271#15C0GH5###V | A271#15C0GK5###V |
| 330 | A331#15C0GF5###V | A331#15C0GH5###V | A331#15C0GK5###V |
| 390 | A391#15C0GF5###V | A391#15C0GH5###V | A391#15C0GK5###V |
| 470 | A471#15C0GF5###V | A471#15C0GH5###V | A471#15C0GK5###V |
| 560 | A561#15C0GF5###V | A561#15C0GH5###V | A561#15C0GK5###V |
| 680 | A681#15C0GF5###V | A681#15C0GH5###V | A681#15C0GK5###V |
| 820 | A821#15C0GF5###V | A821#15C0GH5###V | A821#15C0GK5###V |
| 1000 | A102#15C0GF5###V | A102#15C0GH5###V | A102#15C0GK5###V |
| 1200 | A122#15C0GF5###V | A122#15C0GH5###V | - |
| 1500 | A152#15C0GF5###V | A152#15C0GH5###V | - |
| 1800 | A182#15C0GF5###V | A182#15C0GH5###V | - |
| 2200 | A222#15C0GF5###V | A222#20C0GH5###V | - |
| 2700 | A272#15C0GF5###V | A272#20C0GH5###V | - |
| 3300 | A332#15C0GF5###V | A332#20C0GH5###V | - |
| 3900 | A392#15C0GF5###V | A392#20C0GH5###V | - |
| 4700 | A472#20C0GF5###V | A472#20C0GH5###V | - |
| 5600 | A562#20C0GF5###V | A562#20C0GH5###V | - |
| 6800 | A682#20C0GF5###V | A682#20C0GH5###V | - |
| 8200 | A822#20C0GF5###V | A822#20C0GH5###V | - |
| 10 000 | A103#20C0GF5###V | A103#20C0GH5###V | - |

**Notes**

- Lead diameter is 0.5 mm
- # 5th digit is capacitance tolerance code: ± 5 % = J; ± 10 % = K
- # 13th, 14th and 15th digits are packaging code: reel = TAA; ammo = UAA

RoHS-compliant

Not RoHS-compliant, for fully RoHS-compliant alternative A...R Series, please refer to www.vishay.com/doc?45231

| DIELECTRIC X7R | | | |
|---|---|---|---|
| CAP. (pF) | 50 $V_{DC}$ | 100 $V_{DC}$ | 200 $V_{DC}$ |
| 330 | - | - | A331#15X7RK5###V |
| 390 | - | - | A391#15X7RK5###V |
| 470 | A471#15X7RF5###V | A471#15X7RH5###V | A471#15X7RK5###V |
| 560 | A561#15X7RF5###V | A561#15X7RH5###V | A561#15X7RK5###V |
| 680 | A681#15X7RF5###V | A681#15X7RH5###V | A681#15X7RK5###V |
| 820 | A821#15X7RF5###V | A821#15X7RH5###V | A821#15X7RK5###V |
| 1000 | A102#15X7RF5###V | A102#15X7RH5###V | A102#15X7RK5###V |
| 1200 | A122#15X7RF5###V | A122#15X7RH5###V | A122#15X7RK5###V |
| 1500 | A152#15X7RF5###V | A152#15X7RH5###V | A152#15X7RK5###V |
| 1800 | A182#15X7RF5###V | A182#15X7RH5###V | A182#15X7RK5###V |
| 2200 | A222#15X7RF5###V | A222#15X7RH5###V | A222#15X7RK5###V |
| 2700 | A272#15X7RF5###V | A272#15X7RH5###V | A272#15X7RK5###V |
| 3300 | A332#15X7RF5###V | A332#15X7RH5###V | A332#15X7RK5###V |
| 3900 | A392#15X7RF5###V | A392#15X7RH5###V | A392#15X7RK5###V |
| 4700 | A472#15X7RF5###V | A472#15X7RH5###V | A472#15X7RK5###V |
| 5600 | A562#15X7RF5###V | A562#15X7RH5###V | A562#15X7RK5###V |
| 6800 | A682#15X7RF5###V | A682#15X7RH5###V | A682#15X7RK5###V |
| 8200 | A822#15X7RF5###V | A822#15X7RH5###V | A822#15X7RK5###V |
| 10 000 | A103#15X7RF5###V | A103#15X7RH5###V | A103#15X7RK5###V |
| 12 000 | A123#15X7RF5###V | A123#15X7RH5###V | A123#15X7RK5###V |
| 15 000 | A153#15X7RF5###V | A153#15X7RH5###V | A153#15X7RK5###V |
| 18 000 | A183#15X7RF5###V | A183#15X7RH5###V | A183#15X7RK5###V |
| 22 000 | A223#15X7RF5###V | A223#15X7RH5###V | A223#15X7RK5###V |
| 27 000 | A273#15X7RF5###V | A273#15X7RH5###V | A273#15X7RK5###V |
| 33 000 | A333#15X7RF5###V | A333#15X7RH5###V | A333#20X7RK5###V |
| 39 000 | A393#15X7RF5###V | A393#15X7RH5###V | A393#20X7RK5###V |
| 47 000 | A473#15X7RF5###V | A473#15X7RH5###V | A473#20X7RK5###V |
| 56 000 | A563#15X7RF5###V | A563#15X7RH5###V | A563#20X7RK5###V |
| 68 000 | A683#15X7RF5###V | A683#15X7RH5###V | A683#20X7RK5###V |
| 82 000 | A823#15X7RF5###V | A823#15X7RH5###V | - |
| 100 000 | A104#15X7RF5###V | A104#15X7RH5###V | - |
| 150 000 | A154#15X7RF5###V | A154#20X7RH5###V | - |
| 220 000 | A224#20X7RF5###V | A224#20X7RH5###V | - |
| 330 000 | A334#20X7RF5###V | A334#20X7RH5###V (1) | - |
| 470 000 | A474#20X7RF5###V | A474#20X7RH5###V (1) | - |
| 560 000 | A564#20X7RF5###V (1) | - | - |
| 680 000 | A684#20X7RF5###V (1) | - | - |
| 1 000 000 | A105#20X7RF5###V (1) | - | - |

**Notes**

(1) The Ø D is 4.5 mm max.

- Lead diameter is 0.5 mm
- # 5th digit is capacitance tolerance code: ± 10 % = K; ± 20 % = M
- # 13th, 14th and 15th digits are packaging code: reel = TAA; ammo = UAA

RoHS-compliant

Not RoHS-compliant, for fully RoHS-compliant alternative A...R Series, please refer to www.vishay.com/doc?45231

| DIELECTRIC X8R | |
|---|---|
| CAP. (pF) | 50 $V_{DC}$ |
| 470 | A471#15X8RF5###V |
| 560 | A561#15X8RF5###V |
| 680 | A681#15X8RF5###V |
| 820 | A821#15X8RF5###V |
| 1000 | A102#15X8RF5###V |
| 1200 | A122#15X8RF5###V |
| 1500 | A152#15X8RF5###V |
| 1800 | A182#15X8RF5###V |
| 2200 | A222#15X8RF5###V |
| 2700 | A272#15X8RF5###V |
| 3300 | A332#15X8RF5###V |
| 3900 | A392#15X8RF5###V |
| 4700 | A472#15X8RF5###V |
| 5600 | A562#15X8RF5###V |
| 6800 | A682#15X8RF5###V |
| 8200 | A822#15X8RF5###V |
| 10 000 | A103#15X8RF5###V |
| 12 000 | A123#15X8RF5###V |
| 15 000 | A153#15X8RF5###V |
| 18 000 | A183#15X8RF5###V |
| 22 000 | A223#15X8RF5###V |
| 27 000 | A273#15X8RF5###V |
| 33 000 | A333#15X8RF5###V |
| 39 000 | A393#15X8RF5###V |
| 47 000 | A473#15X8RF5###V |
| 56 000 | A563#15X8RF5###V |
| 68 000 | A683#20X8RF5###V |
| 82 000 | A823#20X8RF5###V |
| 100 000 | A104#20X8RF5###V |
| 150 000 | A154#20X8RF5###V (1) |
| 220 000 | A224#20X8RF5###V (1) |
| 330 000 | A334#20X8RF5###V (1) |

**Notes**

(1) The Ø D is 4.5 mm max.

- Lead diameter is 0.5 mm
- # 5th digit is capacitance tolerance code: ± 10 % = K; ± 20 % = M
- # 13th, 14th and 15th digits are packaging code: reel = TAA; ammo = UAA

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## TAPING AND PACKAGING

### LABELLING

Each reel is provided with a label showing the following details:

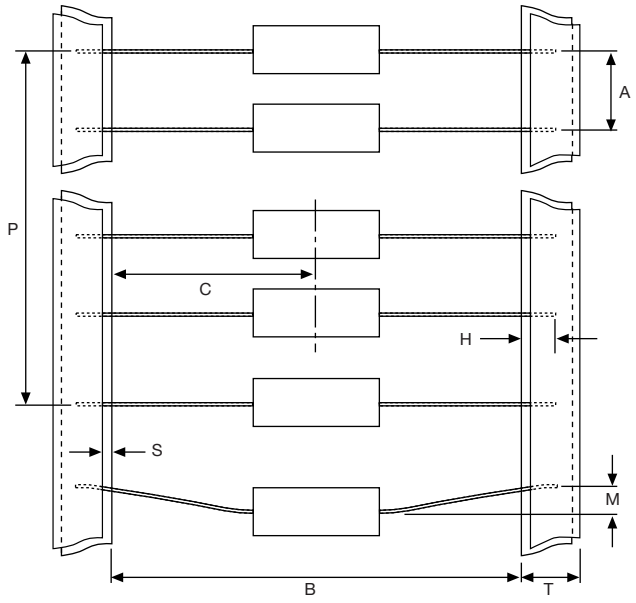
manufacturer, A style, capacitance, tolerance, batch number, quantity of components, rated voltage, dielectric.

On special request other designations can be shown.

For example:


| PACKAGING QUANTITIES AND BOX DIMENSIONS | | | |
|---|---|---|---|
| **PACKAGING** | **SIZE CODE** | **SMALLEST PACKAGING QUANTITY (SPQ)** | **BOX DIMENSIONS L x W x H (mm)** |
| Tape on reel | 15, 20 | 7000 | 370 x 370 x 90 |
| Ammopack | 15, 20 | 4000 | 265 x 85 x 95 |

### CAPACITORS ON BANDOLIER FOR DIPPED AXIAL




| PARAMETER | SYMBOL | DIMENSIONS | |
|---|---|---|---|
| | | mm | INCH |
| Inside tape spacing | B (1) | 52.4 ± 1.5 | 2.062 ± 0.059 |
| Center to tape spacing | C | ± 0.8 | ± 0.031 |
| Cumulative pitch, 6 consecutive components | P | ± 1.5 | ± 0.059 |
| Components pitch | A | 5.0 ± 0.5 | 0.197 ± 0.015 |
| Lead bend | M | < 1.2 | < 0.047 |
| Exposed adhesive | S | < 0.51 | > 0.020 |
| Tape width | T | 6.35 | 0.250 |
| Lead sandwich | H | > 3.96 | > 0.156 |

**Note**

(1) Inside tape spacing 26.0 mm + 1.51 mm/- 0.0 mm is available on request

## REEL DATA

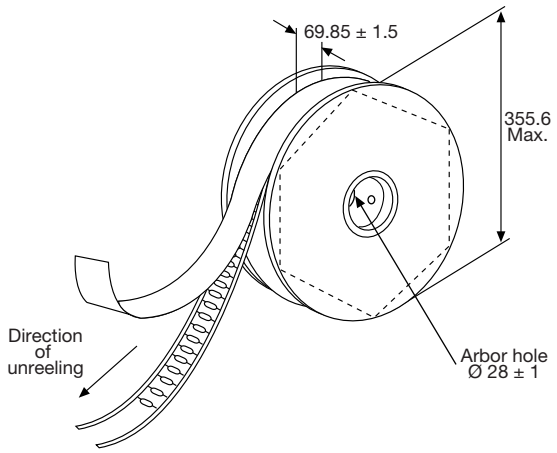
A maximum of 0.5 % of the total number of capacitors per reel may be missing.

A maximum of 1 consecutive vacant positions is followed by 6 consecutive components.

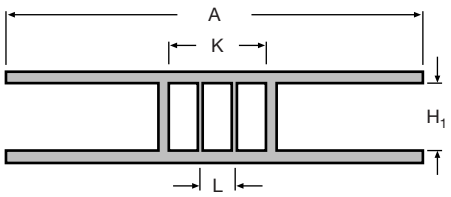
Tape begins and ends with a minimum of 4 empty positions (180 mm tape).

Maximum of 5 splicers per reel.

## REEL




## REEL DIMENSIONS




| REEL SIZE | | (mm) |
|---|---|---|
| A | Outer diameter | 355.6 max. |
| L | Hole diameter | 28 ± 1 |
| K | Core diameter | 90 |
| $H_1$ | Internal width | 69.9 ± 1.5 |

## AMMOPACK DATA

A maximum of 0.5 % of the total number of capacitors per pack may be missing.

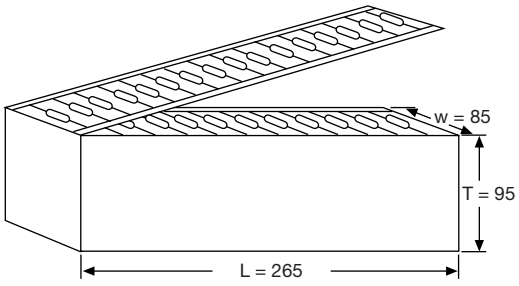
A maximum of 1 consecutive vacant positions is followed by 6 consecutive components.

Tape begins and ends with a minimum of 4 empty positions (180 mm tape).

Maximum of 5 splicers per pack.

The cumulative pitch tolerance over 20 consecutive units is not to exceed ± 1.0 mm.

## AMMOPACK




## RELATED DOCUMENTS

| | |
|---|---|
| General Information | www.vishay.com/doc?45214 |

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