

# Axial Leaded Multilayer Ceramic Capacitors for Automotive Applications

## Class 1 and Class 2, 50 V<sub>DC</sub>, 100 V<sub>DC</sub>, 200 V<sub>DC</sub>



### 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 new designs the series A...P is recommended ([www.vishay.com/ppg?45249](http://www.vishay.com/ppg?45249))
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

### APPLICATIONS

- Automotive

### QUICK REFERENCE DATA

| DESCRIPTION                | VALUE |      |      |           |         |        |         |        |
|----------------------------|-------|------|------|-----------|---------|--------|---------|--------|
| Ceramic class              | 1     |      |      | 2         |         |        |         |        |
| Ceramic dielectric         | C0G   |      |      | X7R       |         |        | X8R     |        |
| Voltage (V <sub>DC</sub> ) | 50    | 100  | 200  | 50        | 100     | 200    | 50      | 100    |
| Min. capacitance (pF)      | 100   | 100  | 100  | 470       | 470     | 330    | 470     | 470    |
| Max. capacitance (pF)      | 8200  | 8200 | 1000 | 1 000 000 | 470 000 | 68 000 | 150 000 | 27 000 |
| 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<sub>DC</sub>, 100 V<sub>DC</sub>, 200 V<sub>DC</sub>

### TEST VOLTAGE

- 50 V<sub>DC</sub> and 100 V<sub>DC</sub>: 250 % of rated voltage
- 200 V<sub>DC</sub>: 200 % of rated voltage

### INSULATION RESISTANCE

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

### DISSIPATION FACTOR

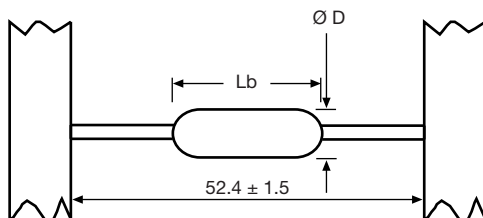
Class 1: 0.1 % max.

(at 1 MHz, 1 V where C ≤ 1000 pF;

at 1 kHz; 1 V where C > 1000 pF)

Class 2: 2.5 % max.

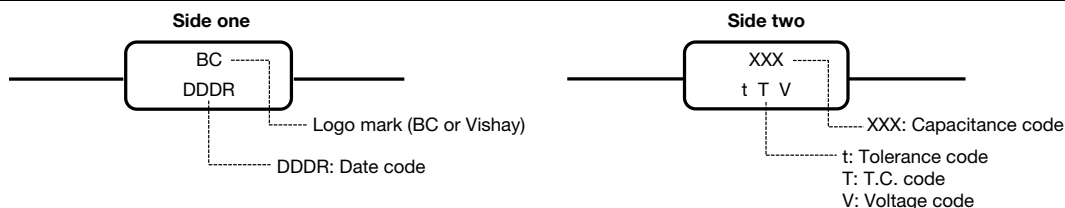
(at 1 kHz, 1 V)

**DIMENSIONS** (in millimeters)


| SIZE CODE | Lb <sub>MAX.</sub> | ØD <sub>MAX.</sub> |
|-----------|--------------------|--------------------|
| 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.<br>For example:<br>109 = 2011, 9 <sup>th</sup> week<br>217 = 2012, 17 <sup>th</sup> week | Two significant digits followed by one digit for the multiplier as given below.<br>1 = * 10, 2 = * 100,<br>3 = * 1000, 4 = * 10 000,<br>5 = * 100 000 | J = ± 5 %<br>K = ± 10 %<br>M = ± 20 % | 1 = 100 V<br>2 = 200 V<br>5 = 50 V | A = C0G (NP0)<br>C = X7R |

**ORDERING CODE INFORMATION**

| A                     | 104                                                                                                                                                                                    | K                                     | 15                                 | X7R                                | F                                                                            | 5                     | TAA                      | R                                         |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------------------------------------|------------------------------------|------------------------------------------------------------------------------|-----------------------|--------------------------|-------------------------------------------|
| 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:<br>1 = * 10<br>2 = * 100<br>3 = * 1000<br>4 = * 10 000<br>5 = * 100 000 | J = ± 5 %<br>K = ± 10 %<br>M = ± 20 % | Please refer to relevant datasheet | Please refer to relevant datasheet | F = 50 V <sub>DC</sub><br>H = 100 V <sub>DC</sub><br>K = 200 V <sub>DC</sub> | 5 = 0.50 mm ± 0.05 mm | TAA = reel<br>UAA = ammo | R = AEC-Q200 qualified and RoHS compliant |



## ORDERING CODES

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

## Notes

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



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

**Notes**<sup>(1)</sup> The Ø D is 4.5 mm max.

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



| DIELECTRIC X8R |                    |                     |
|----------------|--------------------|---------------------|
| CAP.<br>(pF)   | 50 V <sub>DC</sub> | 100 V <sub>DC</sub> |
| 470            | A471#15X8RF5###R   | A471#15X8RH5###R    |
| 560            | A561#15X8RF5###R   | A561#15X8RH5###R    |
| 680            | A681#15X8RF5###R   | A681#15X8RH5###R    |
| 820            | A821#15X8RF5###R   | A821#15X8RH5###R    |
| 1000           | A102#15X8RF5###R   | A102#15X8RH5###R    |
| 1200           | A122#15X8RF5###R   | A122#15X8RH5###R    |
| 1500           | A152#15X8RF5###R   | A152#15X8RH5###R    |
| 1800           | A182#15X8RF5###R   | A182#15X8RH5###R    |
| 2200           | A222#15X8RF5###R   | A222#15X8RH5###R    |
| 2700           | A272#15X8RF5###R   | A272#15X8RH5###R    |
| 3300           | A332#15X8RF5###R   | A332#15X8RH5###R    |
| 3900           | A392#15X8RF5###R   | A392#15X8RH5###R    |
| 4700           | A472#15X8RF5###R   | A472#15X8RH5###R    |
| 5600           | A562#15X8RF5###R   | A562#15X8RH5###R    |
| 6800           | A682#15X8RF5###R   | A682#15X8RH5###R    |
| 8200           | A822#15X8RF5###R   | A822#15X8RH5###R    |
| 10 000         | A103#15X8RF5###R   | A103#15X8RH5###R    |
| 12 000         | A123#15X8RF5###R   | A123#15X8RH5###R    |
| 15 000         | A153#15X8RF5###R   | A153#15X8RH5###R    |
| 18 000         | A183#15X8RF5###R   | A183#15X8RH5###R    |
| 22 000         | A223#15X8RF5###R   | A223#15X8RH5###R    |
| 27 000         | A273#15X8RF5###R   | A273#15X8RH5###R    |
| 33 000         | A333#15X8RF5###R   | -                   |
| 39 000         | A393#15X8RF5###R   | -                   |
| 47 000         | A473#15X8RF5###R   | -                   |
| 56 000         | A563#15X8RF5###R   | -                   |
| 68 000         | A683#20X8RF5###R   | -                   |
| 82 000         | A823#20X8RF5###R   | -                   |
| 100 000        | A104#20X8RF5###R   | -                   |
| 150 000        | A154#20X8RF5###R   | -                   |

**Notes**

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

## 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.

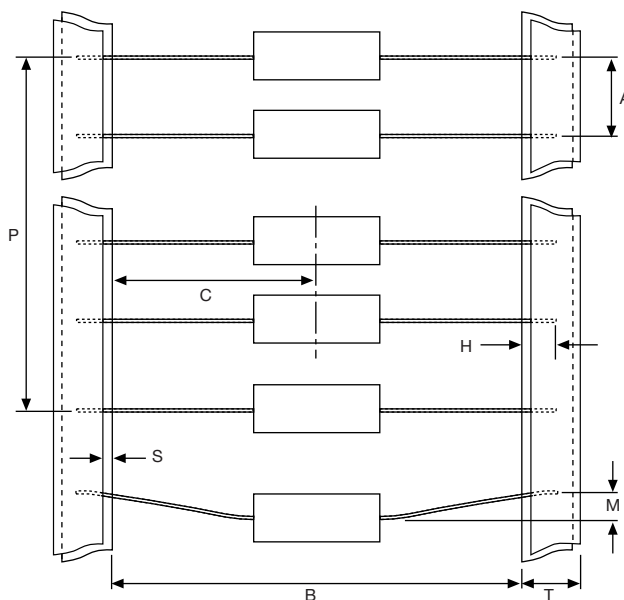
For example:



### 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 <sup>(1)</sup> | 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

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

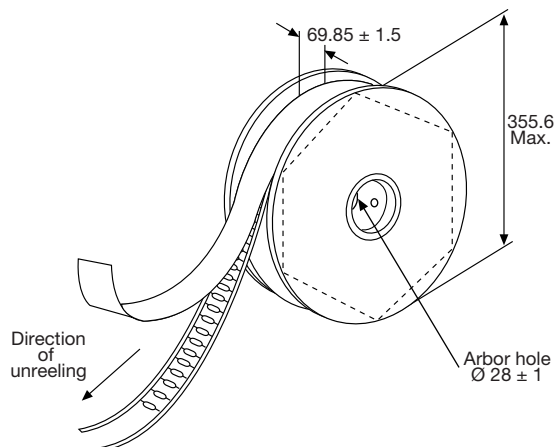
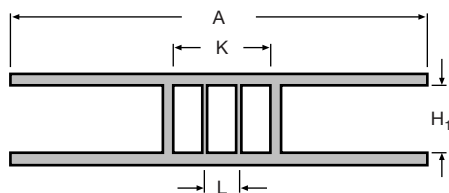
**REEL DATA**

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 <sub>1</sub> | Internal width | 69.9 ± 1.5 |

**AMMOPACK DATA**

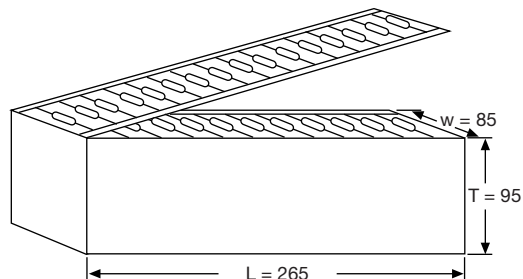
A maximum of 0.5 % of the total number of capacitors per pack may be missing.

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](http://www.vishay.com/doc?45214)



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