

# Radial 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
- Radial mounting style
- Crimp and straight leadstyles
- Parts compliant with ELV Directive
- For fully RoHS-compliant alternative K...R Series, please refer to [www.vishay.com/doc?45233](http://www.vishay.com/doc?45233)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

 AUTOMOTIVE  
GRADE

**RoHS\***  
Available

**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	COG			X7R			X8R
Voltage (V <sub>DC</sub> )	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	100 000	330 000
Mounting	Radial						

**MARKING**

Marking indicates capacitance value and tolerance in accordance with "EIA 198".

**OPERATING TEMPERATURE RANGE**

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

**TEMPERATURE CHARACTERISTICS**

Class 1: COG

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 (nickel wires for welding are available on request)
- The capacitors may be supplied with straight or kinked leads having a lead spacing of 2.5 mm and 5.0 mm
- 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.

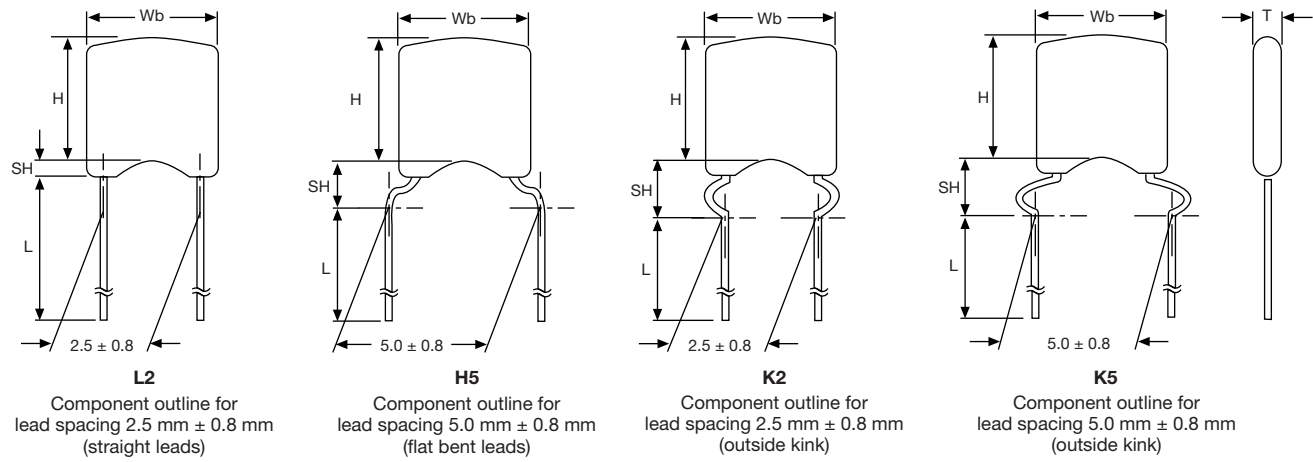
**DISSIPATION FACTOR**

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.

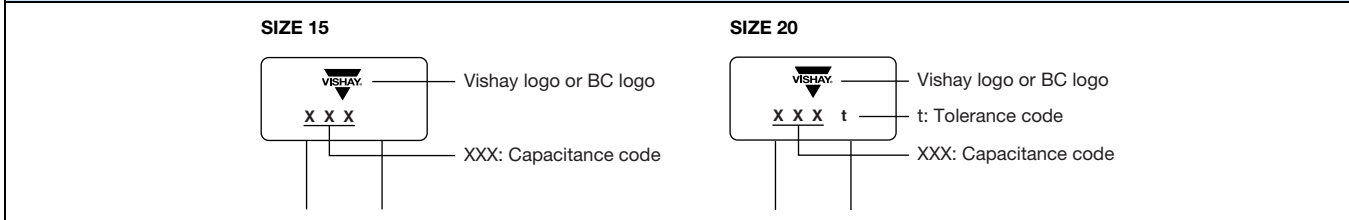
(at 1 kHz, 1 V)

**LEAD CONFIGURATION AND DIMENSIONS** in millimeters


SIZE CODE	W <sub>b</sub> MAX.	H <sub>MAX.</sub>	T <sub>MAX.</sub>	Lead Diameter	MAXIMUM SEATING HEIGHT (SH)			
					L2	H5	K2	K5
15	3.0 - 3.8	2.0 - 3.8	1.6 - 2.6	$0.50 \pm 0.05$	1.6	2.6	3.5	3.5
20	4.3 - 5.1	2.5 - 5.1	1.9 - 3.2	$0.50 \pm 0.05$	1.6	2.6	3.5	3.5

**Notes**

- Bulk packed types have a standard lead length  $L = 30 \text{ mm} \pm 5 \text{ mm}$ .
- L2 and H5 are preferred styles.

**MARKING**

**Notes**

- Two significant digits followed by one digit for the multiplier as given following: 1 = \* 10, 2 = \* 100, 3 = \* 1000, 4 = \* 10 000, 5 = \* 100 000
- The tolerance codes are J = 5 %, K = 10 %, M = 20 %

**ORDERING CODE INFORMATION**

Product Type	Capacitance (pF)	Capacitance Tolerance	Size Code	T.C. Code	Rated Voltage	Lead Diameter	Packaging / Lead Length	Lead Style	Lead Spacing	AEC-Q200 qualified
K = radial 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 = $\pm 5 \%$ K = $\pm 10 \%$ M = $\pm 20 \%$	Please refer to relevant datasheet	Please refer to relevant datasheet	F = 50 V <sub>DC</sub> H = 100 V <sub>DC</sub> K = 200 V <sub>DC</sub>	5 = 0.50 mm $\pm 0.05$ mm	3 = bulk T = tape and reel U = ammo	H = flat crimp L = straight K = outside crimp	2 = 2.5 mm 5 = 5.0 mm	V = AEC-Q200 qualified



ORDERING CODES

DIELECTRIC COG			
CAP. (pF)	50 V <sub>DC</sub>	100 V <sub>DC</sub>	200 V <sub>DC</sub>
100	K101#15C0GF5###V	K101#15C0GH5###V	K101#15C0GK5###V
120	K121#15C0GF5###V	K121#15C0GH5###V	K121#15C0GK5###V
150	K151#15C0GF5###V	K151#15C0GH5###V	K151#15C0GK5###V
180	K181#15C0GF5###V	K181#15C0GH5###V	K181#15C0GK5###V
220	K221#15C0GF5###V	K221#15C0GH5###V	K221#15C0GK5###V
270	K271#15C0GF5###V	K271#15C0GH5###V	K271#15C0GK5###V
330	K331#15C0GF5###V	K331#15C0GH5###V	K331#15C0GK5###V
390	K391#15C0GF5###V	K391#15C0GH5###V	K391#15C0GK5###V
470	K471#15C0GF5###V	K471#15C0GH5###V	K471#15C0GK5###V
560	K561#15C0GF5###V	K561#15C0GH5###V	K561#15C0GK5###V
680	K681#15C0GF5###V	K681#15C0GH5###V	K681#15C0GK5###V
820	K821#15C0GF5###V	K821#15C0GH5###V	K821#15C0GK5###V
1000	K102#15C0GF5###V	K102#15C0GH5###V	K102#15C0GK5###V
1200	K122#15C0GF5###V	K122#15C0GH5###V	-
1500	K152#15C0GF5###V	K152#15C0GH5###V	-
1800	K182#15C0GF5###V	K182#15C0GH5###V	-
2200	K222#15C0GF5###V	K222#20C0GH5###V	-
2700	K272#15C0GF5###V	K272#20C0GH5###V	-
3300	K332#15C0GF5###V	K332#20C0GH5###V	-
3900	K392#15C0GF5###V	K392#20C0GH5###V	-
4700	K472#20C0GF5###V	K472#20C0GH5###V	-
5600	K562#20C0GF5###V	K562#20C0GH5###V	-
6800	K682#20C0GF5###V	K682#20C0GH5###V	-
8200	K822#20C0GF5###V	K822#20C0GH5###V	-
10 000	K103#20C0GF5###V	K103#20C0GH5###V	-

Notes

- Lead diameter is 0.5 mm
- # 5th digit is capacitance tolerance code: ± 5 % = J; ± 10 % = K
- # 13th digit is packaging code: bulk = 3; reel = T; ammo = U
- # 14th digit is lead style code: L; H; K (L and H are preferred lead configuration)
- # 15th digit is lead spacing code: 2.5 mm = 2; 5.0 mm = 5

RoHS-compliant

Not RoHS-compliant, for fully RoHS-compliant alternative K...R Series, please refer to [www.vishay.com/doc?45233](http://www.vishay.com/doc?45233)



DIELECTRIC X7R			
CAP. (pF)	50 V <sub>DC</sub>	100 V <sub>DC</sub>	200 V <sub>DC</sub>
330	-	-	K331#15X7RK5###V
390	-	-	K391#15X7RK5###V
470	K471#15X7RF5###V	K471#15X7RH5###V	K471#15X7RK5###V
560	K561#15X7RF5###V	K561#15X7RH5###V	K561#15X7RK5###V
680	K681#15X7RF5###V	K681#15X7RH5###V	K681#15X7RK5###V
820	K821#15X7RF5###V	K821#15X7RH5###V	K821#15X7RK5###V
1000	K102#15X7RF5###V	K102#15X7RH5###V	K102#15X7RK5###V
1200	K122#15X7RF5###V	K122#15X7RH5###V	K122#15X7RK5###V
1500	K152#15X7RF5###V	K152#15X7RH5###V	K152#15X7RK5###V
1800	K182#15X7RF5###V	K182#15X7RH5###V	K182#15X7RK5###V
2200	K222#15X7RF5###V	K222#15X7RH5###V	K222#15X7RK5###V
2700	K272#15X7RF5###V	K272#15X7RH5###V	K272#15X7RK5###V
3300	K332#15X7RF5###V	K332#15X7RH5###V	K332#15X7RK5###V
3900	K392#15X7RF5###V	K392#15X7RH5###V	K392#15X7RK5###V
4700	K472#15X7RF5###V	K472#15X7RH5###V	K472#15X7RK5###V
5600	K562#15X7RF5###V	K562#15X7RH5###V	K562#15X7RK5###V
6800	K682#15X7RF5###V	K682#15X7RH5###V	K682#15X7RK5###V
8200	K822#15X7RF5###V	K822#15X7RH5###V	K822#15X7RK5###V
10 000	K103#15X7RF5###V	K103#15X7RH5###V	K103#15X7RK5###V
12 000	K123#15X7RF5###V	K123#15X7RH5###V	K123#15X7RK5###V
15 000	K153#15X7RF5###V	K153#15X7RH5###V	K153#15X7RK5###V
18 000	K183#15X7RF5###V	K183#15X7RH5###V	K183#15X7RK5###V
22 000	K223#15X7RF5###V	K223#15X7RH5###V	K223#15X7RK5###V
27 000	K273#15X7RF5###V	K273#15X7RH5###V	K273#15X7RK5###V
33 000	K333#15X7RF5###V	K333#15X7RH5###V	K333#20X7RK5###V
39 000	K393#15X7RF5###V	K393#15X7RH5###V	K393#20X7RK5###V
47 000	K473#15X7RF5###V	K473#15X7RH5###V	K473#20X7RK5###V
56 000	K563#15X7RF5###V	K563#15X7RH5###V	K563#20X7RK5###V
68 000	K683#15X7RF5###V	K683#15X7RH5###V	K683#20X7RK5###V
82 000	K823#15X7RF5###V	K823#15X7RH5###V	K823#20X7RK5###V
100 000	K104#15X7RF5###V	K104#15X7RH5###V	K104#20X7RK5###V
150 000	K154#15X7RF5###V	K154#20X7RH5###V	-
220 000	K224#20X7RF5###V	K224#20X7RH5###V	-
330 000	K334#20X7RF5###V	K334#20X7RH5###V	-
470 000	K474#20X7RF5###V	K474#20X7RH5###V	-
560 000	K564#20X7RF5###V	-	-
680 000	K684#20X7RF5###V	-	-
1 000 000	K105#20X7RF5###V	-	-

Notes

- Lead diameter is 0.5 mm
- # 5th digit is capacitance tolerance code: ± 10 % = K; ± 20 % = M
- # 13th digit is packaging code: bulk = 3; reel = T; ammo = U
- # 14th digit is lead style code: L; H; K (L and H are preferred lead configuration)
- # 15th digit is lead spacing code: 2.5 mm = 2; 5.0 mm = 5

RoHS-compliant

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DIELECTRIC X8R	
CAP. (pF)	50 V <sub>DC</sub>
470	K471#15X8RF5###V
560	K561#15X8RF5###V
680	K681#15X8RF5###V
820	K821#15X8RF5###V
1000	K102#15X8RF5###V
1200	K122#15X8RF5###V
1500	K152#15X8RF5###V
1800	K182#15X8RF5###V
2200	K222#15X8RF5###V
2700	K272#15X8RF5###V
3300	K332#15X8RF5###V
3900	K392#15X8RF5###V
4700	K472#15X8RF5###V
5600	K562#15X8RF5###V
6800	K682#15X8RF5###V
8200	K822#15X8RF5###V
10 000	K103#15X8RF5###V
12 000	K123#15X8RF5###V
15 000	K153#15X8RF5###V
18 000	K183#15X8RF5###V
22 000	K223#15X8RF5###V
27 000	K273#15X8RF5###V
33 000	K333#15X8RF5###V
39 000	K393#15X8RF5###V
47 000	K473#15X8RF5###V
56 000	K563#15X8RF5###V
68 000	K683#15X8RF5###V
82 000	K823#15X8RF5###V
100 000	K104#15X8RF5###V
150 000	K154#15X8RF5###V
220 000	K224#20X8RF5###V
330 000	K334#20X8RF5###V

Notes

- Lead diameter is 0.5 mm
- # 5th digit is capacitance tolerance code: ± 10 % = K; ± 20 % = M
- # 13th digit is packaging code: bulk = 3; reel = T; ammo = U
- # 14th digit is lead style code: L; H; K (L and H are preferred lead configuration)
- # 15th digit is lead spacing code: 2.5 mm = 2; 5.0 mm = 5

RoHS-compliant

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**TAPING AND PACKAGING**

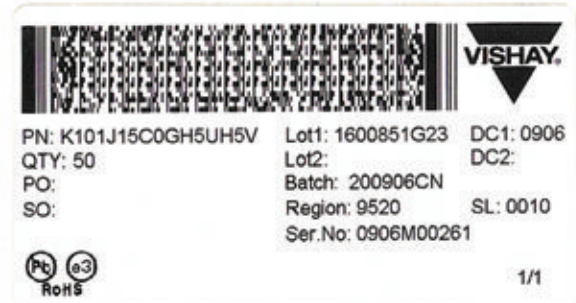
**LABELLING**

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

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

On special request other designations can be shown.

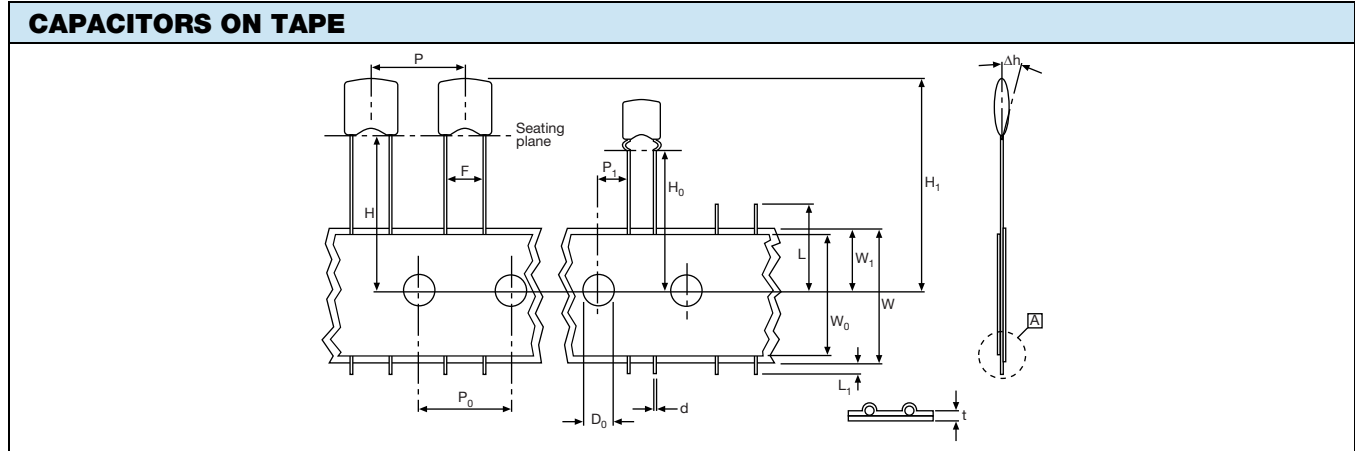
For example:



PACKAGING QUANTITIES AND BOX DIMENSIONS			
PACKAGING	SIZE CODE	SMALLEST PACKAGING QUANTITY (SPQ)	BOX DIMENSIONS L x W x H (mm)
Tape on reel	15	4000	370 x 370 x 60
	20	3000	
Ampopack	15, 20	2500	335 x 290 x 50
Bulk <sup>(1)</sup>	15, 20	5000	245 x 120 x 65

**Note**

<sup>(1)</sup> SPQ contains one or a multiple of poly-bags, 1000 units per bag.



PARAMETER	SYMBOL	DIMENSIONS	
		mm	INCH
Cut-off length	L	≤ 11.0	≤ 0.443
Lead end protrusion	L <sub>1</sub>	≤ 1.0	≤ 0.039
Height to seating plane (straight leads)	H	≥ 18.0	≥ 0.709
Height to seating plane (crimp leads)	H <sub>0</sub>	16.0 ± 0.5	0.630 ± 0.020
Top of component height	H <sub>1</sub>	≤ 32	≤ 1.26
Body inclination	Δh	0.0 ± 1.0	0.000 ± 0.039
Carrier tape width	W	18.0 + 1.0 / - 0.5	0.709 + 0.039 / - 0.020
Hold down tape width	W <sub>0</sub>	15.0 REF.	0.591 REF.
Sprocket hole position	W <sub>1</sub>	9.00 + 0.075 / - 0.50	0.354 + 0.030 / - 0.020
Lead space	F	2.50 + 0.60 / - 0.40	0.100 + 0.024 / - 0.016
		5.00 + 0.60 / - 0.40	0.200 + 0.024 / - 0.016
Sprocket hole pitch	P <sub>0</sub>	12.70 ± 0.30	0.500 ± 0.012
Sprocket hole center to lead center at F = 2.5 mm	P <sub>1</sub>	5.08 ± 0.70	0.200 ± 0.028
Sprocket hole center to lead center at F = 5 mm		3.85 ± 0.70	0.150 ± 0.028
Sprocket hole diameter	D <sub>0</sub>	4.00 ± 0.30	0.157 ± 0.012
Overall tape thickness	t	≤ 0.90	≤ 0.035
Wire lead diameter	d	0.50 ± 0.05	0.020 ± 0.002
Taping pitch	P	12.7 REF.	0.50 REF.

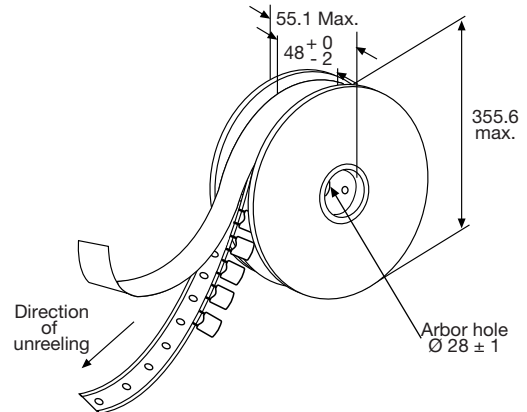
**REEL DATA**

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 (50 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	48 + 0 / - 2	
H <sub>2</sub>	External width	55 max.	

**AMMOPACK DATA**

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

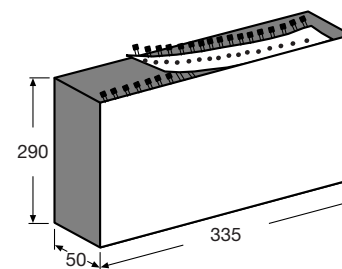
A maximum of 1 consecutive vacant positions is followed by 6 consecutive components.

Tape begins and ends with a minimum of 4 empty positions (50 mm tape).

Maximum of 5 splicers per pack.

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

Lead space (F) shall be measured at (3.6 ± 0.5) mm from the capacitor seating plane.

**AMMOPACK**


RELATED DOCUMENTS	
General Information	<a href="http://www.vishay.com/doc?45214">www.vishay.com/doc?45214</a>



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