

# High Operating Temperature Radial Leaded Multilayer Ceramic Capacitors for Automotive Applications, 50 V<sub>DC</sub>, 100 V<sub>DC</sub>, 200 V<sub>DC</sub>



## FEATURES

- Registered trademark HOTcap®
- AEC-Q200 qualified with PPAP available
- High reliability MLCC insert with wet build process
- High operating temperature up to 200 °C <sup>(1)</sup>
- Available in class 1 and class 2
- High capacitance with small size
- Radial mounting style
- Crimp and straight leadstyles
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**

COMPLIANT

HALOGEN

FREE

## LINKS TO ADDITIONAL RESOURCES



3D Models

## APPLICATIONS

- Automotive applications up to 200 °C <sup>(1)</sup>

### Note

<sup>(1)</sup> 200 °C for max. 500 hours and 175 °C unlimited time

QUICK REFERENCE DATA						
DESCRIPTION	VALUE					
Ceramic class	1			2		
Ceramic dielectric	C0G			X0U		
Voltage (V <sub>DC</sub> )	50	100	200	50	100	200
Min. capacitance (pF)	100	100	100	10 000	10 000	10 000
Max. capacitance (pF)	12 000	12 000	8200	1 000 000	470 000	180 000
Mounting	Radial					

## MARKING

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

## OPERATING TEMPERATURE RANGE

-55 °C to +175 °C unlimited time  
-55 °C to +200 °C for max. 500 hours  
Voltage derating above 150 °C

## TEMPERATURE CHARACTERISTICS

Class 1: C0G ( $\pm 30$  ppm/K within -55 °C to +200 °C)  
Class 2: X0U also fulfilling X7R and X9V criteria  
X7R (+15 % / -15 % within -55 °C to +125 °C)  
X0U (+22 % / -56 % within -55 °C to +175 °C)  
X9V (+22 % / -82 % within -55 °C to +200 °C)  
See also chart "Capacitance Change vs. Temperature"

## SECTIONAL SPECIFICATIONS

Climatic category (acc. to EN 60058-1)  
55 / 125 / 21

## APPROVALS

EIA 198  
IEC 60384-8  
IEC 60384-9  
AEC-Q200

## DISSIPATION FACTOR

Class 1: 0.1 % max.  
(C  $\leq$  1000 pF, at 1 MHz, 1 V; C > 1000 pF, at 1 kHz, 1 V)  
Class 2: 2.5 % max. (at 1 kHz, 1 V)

## DESIGN

- The capacitors consist of a high reliability MLCC
- Leads wires are 0.5 mm or 0.6 mm and are made of 100 % tinned copper clad steel wire
- 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 flame retardant epoxy resin in accordance with UL 94 V-0

## CAPACITANCE RANGE

100 pF to 1  $\mu$ F

## TOLERANCE ON CAPACITANCE

$\pm 5$  %,  $\pm 10$  %,  $\pm 20$  %

## RATED VOLTAGE

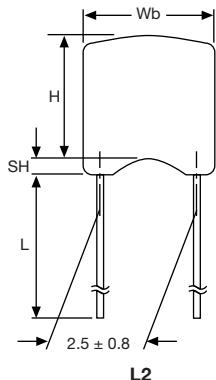
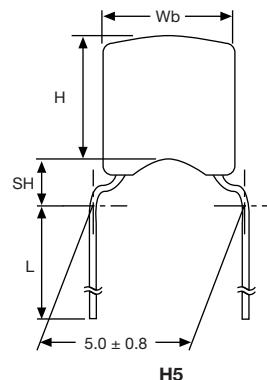
50 V<sub>DC</sub>, 100 V<sub>DC</sub>, 200 V<sub>DC</sub>

## 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

- 50 V<sub>DC</sub>, 100 V<sub>DC</sub>: 100 G $\Omega$  or 1000  $\Omega$ F whichever is less at rated voltage within 2 min of charging
- 200 V<sub>DC</sub>: 10 G $\Omega$  or 100  $\Omega$ F whichever is less at rated voltage within 2 min of charging

**LEAD CONFIGURATION AND DIMENSIONS** in millimeters

 Component outline for lead spacing  $2.5 \text{ mm} \pm 0.5 \text{ mm}$   
 (straight leads)

 Component outline for lead spacing  $5.0 \text{ mm} \pm 0.5 \text{ mm}$   
 (flat bent leads)

SIZE CODE	W <sub>b</sub> MAX.	H <sub>MAX.</sub>	T <sub>MAX.</sub>	LEAD DIAMETER	MAXIMUM SEATING HEIGHT (SH)	
					L2	H5
15	3.0 - 3.8	2.0 - 3.8	1.6 - 2.6	0.50 ± 0.05	1.6	2.6
20	4.3 - 5.1	2.5 - 5.1	1.9 - 3.2	0.60 ± 0.05	1.6	2.6

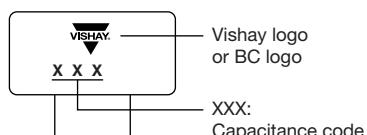
**Notes**

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

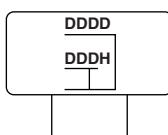
**MARKING** (two sides)

**SIZE 15 CAPACITANCE VALUE ≥ 100 pF**

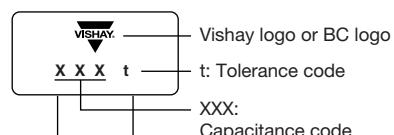
## Side One



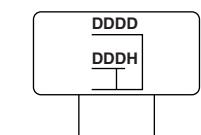
## Side Two


**SIZE 20**

## Side One



## Side Two


**Notes**

- Two significant digits followed by one digit for the multiplier: 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**

K	104	K	15	XOU	F	5	3	H	5	H
1	2 3 4	5	6 7	8 9 10	11	12	13	14	15	16
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 = ± 5 % K = ± 10 % M = ± 20 %	Please refer to relevant ordering code tables in this datasheet	Please refer to relevant ordering code tables in this datasheet	F = 50 V <sub>DC</sub> H = 100 V <sub>DC</sub> K = 200 V <sub>DC</sub>	5 = 0.50 mm ± 0.05 mm 6 = 0.60 mm ± 0.05 mm	3 = bulk T = tape and reel U = ammo	H = flat crimp L = straight U = outside crimp	2 = 2.5 mm 5 = 5.0 mm	H = high operating temperature

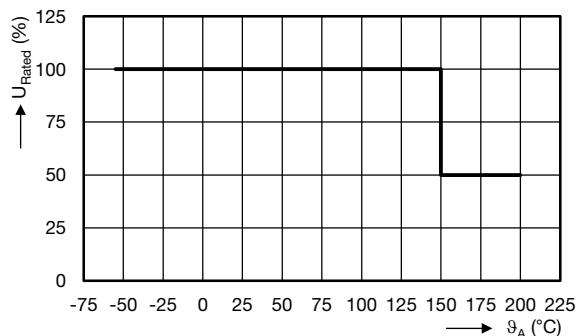
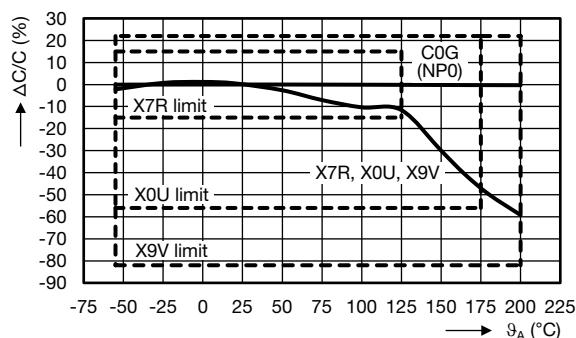
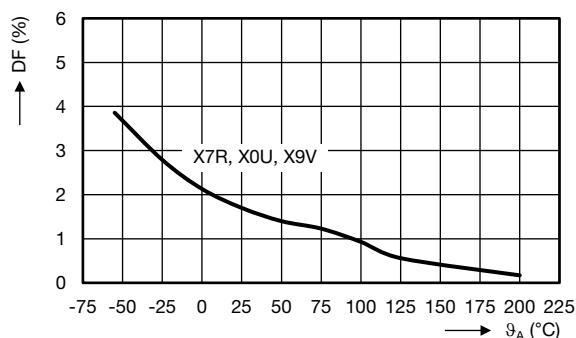
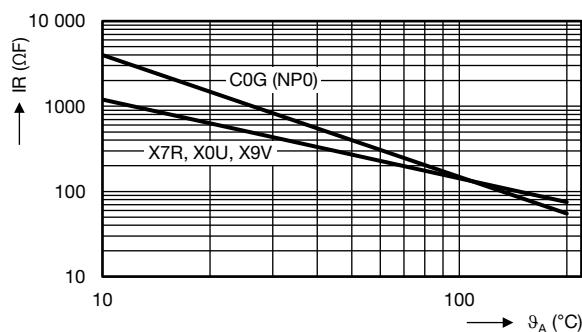
**ORDERING CODES**

<b>DIELECTRIC COG</b>			
<b>CAP. (pF)</b>	<b>50 V<sub>DC</sub></b>	<b>100 V<sub>DC</sub></b>	<b>200 V<sub>DC</sub></b>
100	K101#15C0GF5###H	K101#15C0GH5###H	K101#15C0GK5###H
120	K121#15C0GF5###H	K121#15C0GH5###H	K121#15C0GK5###H
150	K151#15C0GF5###H	K151#15C0GH5###H	K151#15C0GK5###H
180	K181#15C0GF5###H	K181#15C0GH5###H	K181#15C0GK5###H
220	K221#15C0GF5###H	K221#15C0GH5###H	K221#15C0GK5###H
270	K271#15C0GF5###H	K271#15C0GH5###H	K271#15C0GK5###H
330	K331#15C0GF5###H	K331#15C0GH5###H	K331#15C0GK5###H
390	K391#15C0GF5###H	K391#15C0GH5###H	K391#15C0GK5###H
470	K471#15C0GF5###H	K471#15C0GH5###H	K471#15C0GK5###H
560	K561#15C0GF5###H	K561#15C0GH5###H	K561#15C0GK5###H
680	K681#15C0GF5###H	K681#15C0GH5###H	K681#15C0GK5###H
820	K821#15C0GF5###H	K821#15C0GH5###H	K821#15C0GK5###H
1000	K102#15C0GF5###H	K102#15C0GH5###H	K102#15C0GK5###H
1200	K122#15C0GF5###H	K122#15C0GH5###H	K122#20C0GK6###H
1500	K152#15C0GF5###H	K152#15C0GH5###H	K152#20C0GK6###H
1800	K182#15C0GF5###H	K182#15C0GH5###H	K182#20C0GK6###H
2200	K222#15C0GF5###H	K222#20C0GH6###H	K222#20C0GK6###H
2700	K272#15C0GF5###H	K272#20C0GH6###H	K272#20C0GK6###H
3300	K332#15C0GF5###H	K332#20C0GH6###H	K332#20C0GK6###H
3900	K392#15C0GF5###H	K392#20C0GH6###H	K392#20C0GK6###H
4700	K472#20C0GF6###H	K472#20C0GH6###H	K472#20C0GK6###H
5600	K562#20C0GF6###H	K562#20C0GH6###H	K562#20C0GK6###H
6800	K682#20C0GF6###H	K682#20C0GH6###H	K682#20C0GK6###H
8200	K822#20C0GF6###H	K822#20C0GH6###H	K822#20C0GK6###H
12 000	K123#20C0GF6###H	K123#20C0GH6###H	-

<b>DIELECTRIC XOU</b>			
<b>CAP. (pF)</b>	<b>50 V<sub>DC</sub></b>	<b>100 V<sub>DC</sub></b>	<b>200 V<sub>DC</sub></b>
10 000	K103#15X0UF5###H	K103#15X0UH5###H	K103#15X0UK5###H
15 000	K153#15X0UF5###H	K153#15X0UH5###H	K153#15X0UK5###H
22 000	K223#15X0UF5###H	K223#15X0UH5###H	K223#15X0UK5###H
27 000	K273#15X0UF5###H	K273#15X0UH5###H	K273#15X0UK5###H
33 000	K333#15X0UF5###H	K333#15X0UH5###H	K333#20X0UK6###H
39 000	K393#15X0UF5###H	K393#15X0UH5###H	K393#20X0UK6###H
47 000	K473#15X0UF5###H	K473#15X0UH5###H	K473#20X0UK6###H
56 000	K563#15X0UF5###H	K563#15X0UH5###H	K563#20X0UK6###H
68 000	K683#15X0UF5###H	K683#15X0UH5###H	K683#20X0UK6###H
82 000	K823#15X0UF5###H	K823#15X0UH5###H	K823#20X0UK6###H
100 000	K104#15X0UF5###H	K104#15X0UH5###H	K104#20X0UK6###H
120 000	K124#15X0UF5###H	K124#20X0UH6###H	K124#20X0UK6###H
150 000	K154#15X0UF5###H	K154#20X0UH6###H	K154#20X0UK6###H
180 000	K184#20X0UF6###H	K184#20X0UH6###H	K184#20X0UK6###H
220 000	K224#20X0UF6###H	K224#20X0UH6###H	-
270 000	K274#20X0UF6###H	K274#20X0UH6###H	-
330 000	K334#20X0UF6###H	K334#20X0UH6###H	-
390 000	K394#20X0UF6###H	K394#20X0UH6###H	-
470 000	K474#20X0UF6###H	K474#20X0UH6###H	-
560 000	K564#20X0UF6###H	-	-
680 000	K684#20X0UF6###H	-	-
820 000	K824#20X0UF6###H	-	-
1 000 000	K105#20X0UF6###H	-	-

**Notes**

- Lead diameter is 0.5 mm or 0.6 mm
- # 5th digit is capacitance tolerance code:  $\pm 5\% = J$ ;  $\pm 10\% = K$ ;  $\pm 20\% = M$
- # 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

**RATED VOLTAGE VS. TEMPERATURE (Typical)**

**CAPACITANCE CHANGE VS. TEMPERATURE (Typical)**

**DISSIPATION FACTOR VS. TEMPERATURE (Typical)**

**INSULATION RESISTANCE VS. TEMPERATURE (Typical)**


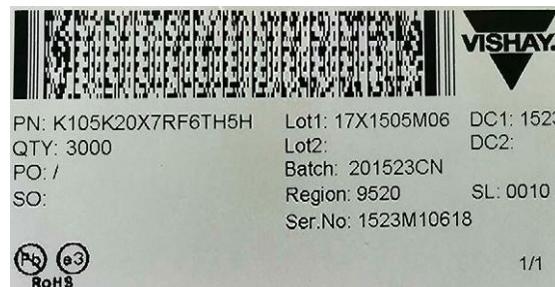
**TAPING AND PACKAGING**
**LABELLING**

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:



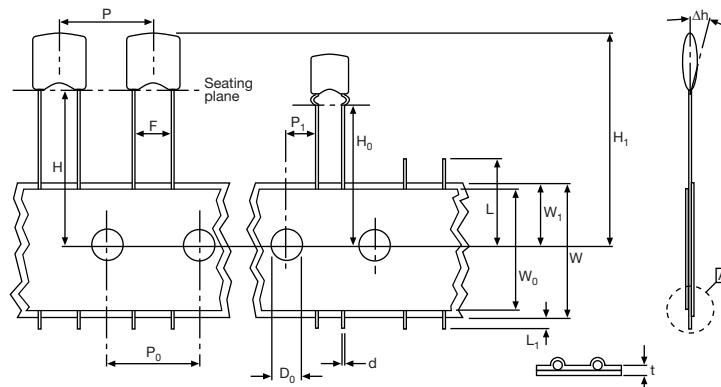
1/1

**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	
Ammopack	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

**CAPACITORS ON TAPE**


PARAMETER	SYMBOL	DIMENSIONS	
		mm	INCH
Cut-off length	L	$\leq 11$	$\leq 0.443$
Lead end protrusion	L <sub>1</sub>	$\leq 1$	$\leq 0.039$
Height to seating plane (straight leads)	H	$\geq 18$	$\geq 0.709$
Height to seating plane (crimp leads)	H <sub>0</sub>	$16.0 \pm 0.5$	$0.630 \pm 0.020$
Top of component height	H <sub>1</sub>	$\leq 32$	$\leq 1.26$
Body inclination	$\Delta h$	$0 \pm 1.0$	$0 \pm 0.039$
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	$2.50 +0.60/-0.40$ $5.00 +0.60/-0.40$	$0.100 +0.024/-0.016$ $0.200 +0.024/-0.016$
Sprocket hole pitch	P <sub>0</sub>	$12.70 \pm 0.30$	$0.500 \pm 0.012$
Sprocket hole center to lead center at F = 2.5 mm	P <sub>1</sub>	$5.08 \pm 0.70$	$0.200 \pm 0.028$
Sprocket hole center to lead center at F = 5 mm		$3.85 \pm 0.70$	$0.150 \pm 0.028$
Sprocket hole diameter	D <sub>0</sub>	$4.0 \pm 0.30$	$0.157 \pm 0.012$
Overall tape thickness	t	$\leq 0.90$	$\leq 0.035$
Wire lead diameter	d	$0.50 \pm 0.05$	$0.020 \pm 0.002$
Taping pitch	P	12.7 REF.	0.50 REF.

## REEL DATA

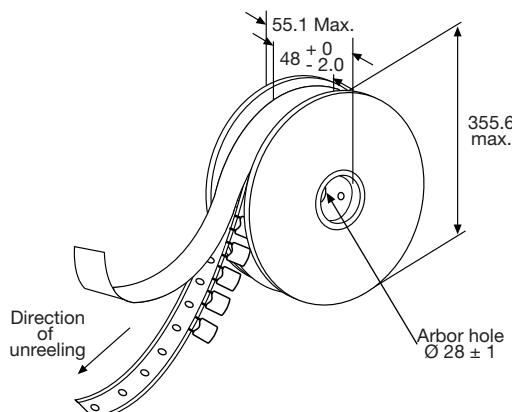
A maximum of 0.5 % of the total number of capacitors per reel may be missing.

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

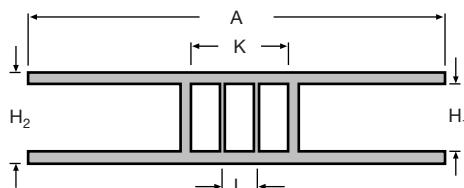
Tape begins and ends with a minimum of 4 empty positions (50 mm tape).

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.

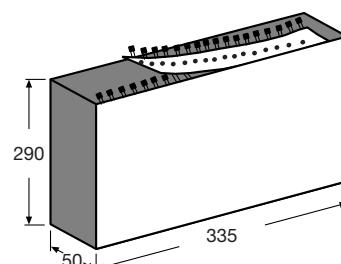
Tape begins and ends with a minimum of 4 empty positions (50 mm tape).

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 mm ± 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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## SAMPLE KIT

Part Number	HOTC-KIT-KH
Link	<a href="http://www.vishay.com/doc?45234">www.vishay.com/doc?45234</a>

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