

# 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>



## DESIGN SUPPORT TOOLS

[click logo to get started](#)


## 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**

## 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 (± 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 ≤ 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 µF

## TOLERANCE ON CAPACITANCE

± 5 %, ± 10 %, ± 20 %

## RATED VOLTAGE

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

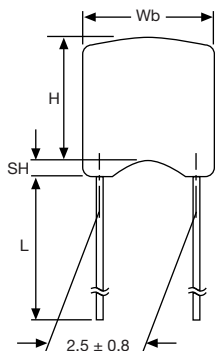
## TEST VOLTAGE

- 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

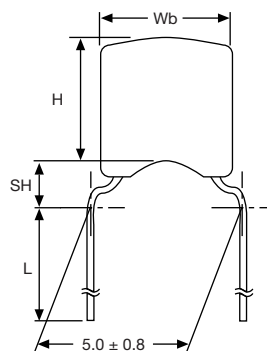
- 50 V<sub>DC</sub>, 100 V<sub>DC</sub>: 100 GΩ or 1000 ΩF whichever is less at rated voltage within 2 min of charging
- 200 V<sub>DC</sub>: 10 GΩ or 100 ΩF whichever is less at rated voltage within 2 min of charging

### LEAD CONFIGURATION AND DIMENSIONS in millimeters



**L2**

Component outline for lead spacing 2.5 mm ± 0.5 mm (straight leads)



**H5**

Component outline for lead spacing 5.0 mm ± 0.5 mm (flat bent leads)

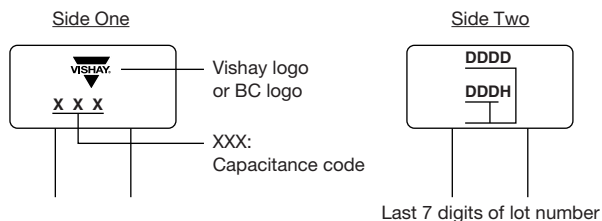
| SIZE CODE | Wb <sub>MAX.</sub> | H <sub>MAX.</sub> | T <sub>MAX.</sub> | LEAD DIAMETER | MAXIMUM SEATING HEIGHT (SH) |     |
|-----------|--------------------|-------------------|-------------------|---------------|-----------------------------|-----|
|           |                    |                   |                   |               | 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

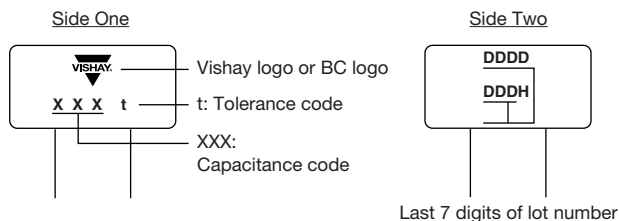
- Bulk packed types have a standard lead length L = 30 mm ± 5 mm.
- L2 and H5 are preferred styles.

### MARKING (two sides)

#### SIZE 15 CAPACITANCE VALUE ≥ 100 pF



#### SIZE 20



#### 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        | X0U       | 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 |



### ORDERING CODE INFORMATION

|                              |                                                                                                                                                                                                          |                                                   |                                                                                      |                                                                                      |                                                                              |                                                              |                                              |                                                           |                          |                                      |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------|-----------------------------------------------------------|--------------------------|--------------------------------------|
| K = radial<br>leaded<br>MLCC | The first two<br>digits are the<br>significant figures<br>of capacitance<br>and the last digit<br>is a multiplier<br>as follows:<br>1 = * 10<br>2 = * 100<br>3 = * 1000<br>4 = * 10 000<br>5 = * 100 000 | J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$ | Please<br>refer to<br>relevant<br>ordering<br>code<br>tables<br>in this<br>datasheet | Please<br>refer to<br>relevant<br>ordering<br>code<br>tables<br>in this<br>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<br>$\pm 0.05$ mm<br>6 = 0.60 mm<br>$\pm 0.05$ mm | 3 = bulk<br>T = tape<br>and reel<br>U = ammo | H = flat<br>crimp<br>L = straight<br>K = outside<br>crimp | 2 = 2.5 mm<br>5 = 5.0 mm | H = high<br>operating<br>temperature |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------|-----------------------------------------------------------|--------------------------|--------------------------------------|



## ORDERING CODES

| DIELECTRIC C0G |                    |                     |                     |
|----------------|--------------------|---------------------|---------------------|
| CAP.<br>(pF)   | 50 V <sub>DC</sub> | 100 V <sub>DC</sub> | 200 V <sub>DC</sub> |
| 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    |
| 10 000         | K103#20C0GF6###H   | K103#20C0GH6###H    | /                   |
| 12 000         | K123#20C0GF6###H   | K123#20C0GH6###H    | /                   |

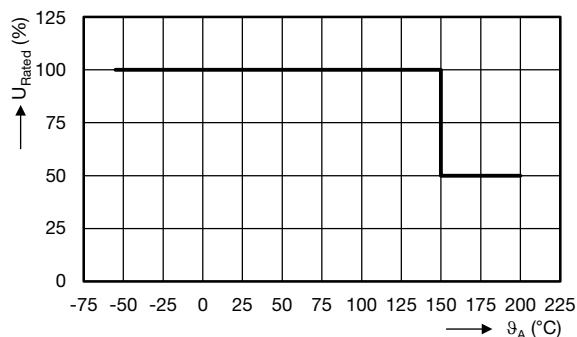
| DIELECTRIC X0U |                    |                     |                     |
|----------------|--------------------|---------------------|---------------------|
| CAP.<br>(pF)   | 50 V <sub>DC</sub> | 100 V <sub>DC</sub> | 200 V <sub>DC</sub> |
| 10 000         | K103#15X0UF5###H   | K103#15X0UH5###H    | 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

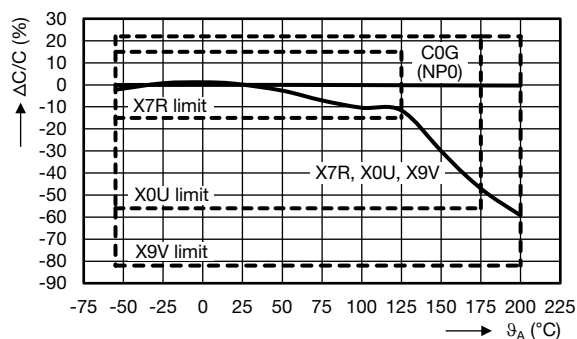
- Lead diameter is 0.5 mm or 0.6 mm
- # 5th digit is capacitance tolerance code:  $\pm 5\%$  = J;  $\pm 10\%$  = K;  $\pm 20\%$  = M
- # 13th digit is packaging code: Bulk = 3; Reel = T; Ammo = U
- # 14th digit is lead style code: L; H; K (L and H are preferred lead configuration)
- # 15th digit is lead spacing code: 2.5 mm = 2; 5.0 mm = 5



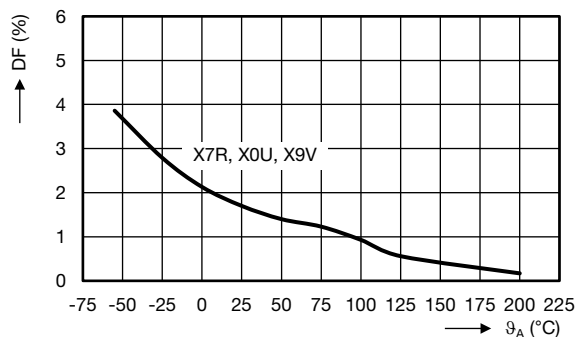
### RATED VOLTAGE VS. TEMPERATURE (Typical)



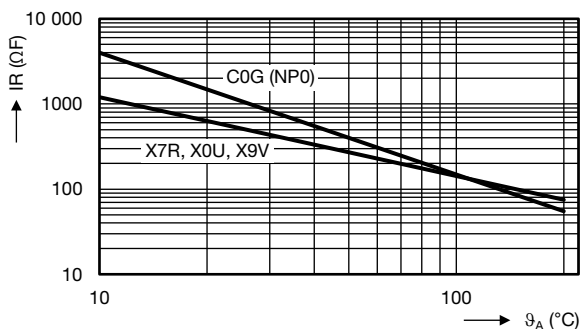
### CAPACITANCE CHANGE VS. TEMPERATURE (Typical)



### DISSIPATION FACTOR VS. TEMPERATURE (Typical)



### INSULATION RESISTANCE VS. TEMPERATURE (Typical)



### TAPING AND PACKAGING

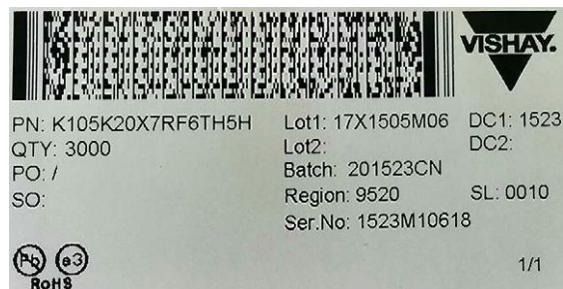
#### LABELLING

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:



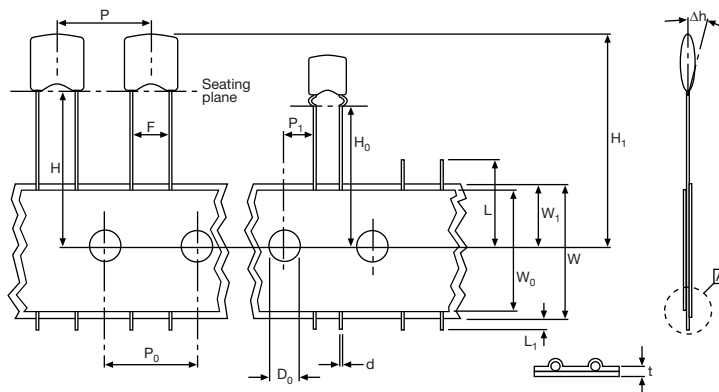
#### PACKAGING QUANTITIES AND BOX DIMENSIONS

| 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>(2)</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              | ≤ 11              | ≤ 0.443             |
| Lead end protrusion                               | L <sub>1</sub> | ≤ 1               | ≤ 0.039             |
| Height to seating plane (straight leads)          | H              | ≥ 18              | ≥ 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 ± 1.0           | 0 ± 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> | 4.0 ± 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       |



| CAPACITORS ON TAPE |   |           |           |
|--------------------|---|-----------|-----------|
| Taping pitch       | P | 12.7 REF. | 0.50 REF. |

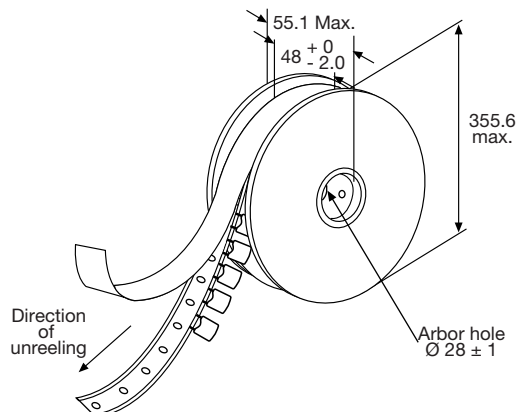
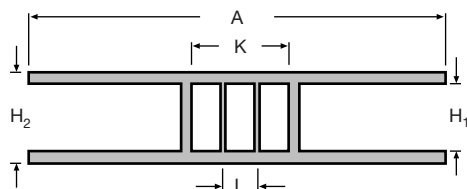
**REEL DATA**

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.

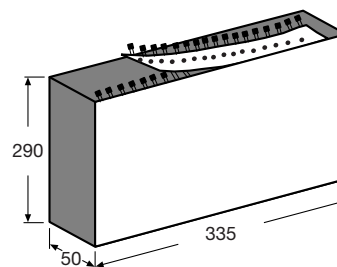
A maximum of 1 consecutive vacant positions is followed by 6 consecutive components.

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> |
|---------------------|------------------------------------------------------------------------|

**SAMPLE KIT**

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



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.