

High Operating Temperature Radial Leaded Multilayer Ceramic Capacitors for Automotive Applications, 50 V_{DC}, 100 V_{DC}, 200 V_{DC}



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 ⁽¹⁾
- 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



RoHS
COMPLIANT
HALOGEN
FREE

LINKS TO ADDITIONAL RESOURCES



3D Models

APPLICATIONS

- Automotive applications up to 200 °C ⁽¹⁾

Note

⁽¹⁾ 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 _{DC}) | 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_{DC}, 100 V_{DC}, 200 V_{DC}

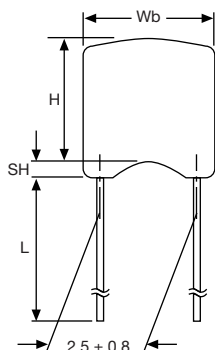
TEST VOLTAGE

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

INSULATION RESISTANCE

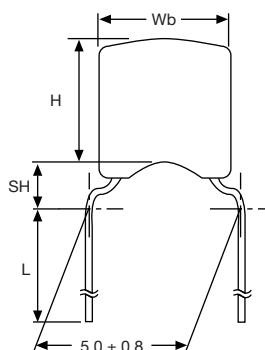
- 50 V_{DC}, 100 V_{DC}: 100 GΩ or 1000 ΩF whichever is less at rated voltage within 2 min of charging
- 200 V_{DC}: 10 GΩ or 100 ΩF whichever is less at rated voltage within 2 min of charging

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)

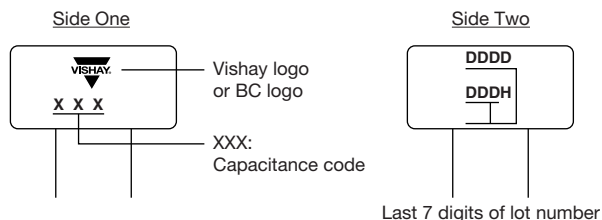
| SIZE CODE | Wb _{MAX.} | H _{MAX.} | T _{MAX.} | LEAD DIAMETER | MAXIMUM SEATING HEIGHT (SH) | |
|-----------|--------------------|-------------------|-------------------|---------------|-----------------------------|-----|
| | | | | | L2 | H5 |
| 15 | 3.0 - 3.8 | 2.0 - 3.8 | 1.6 - 2.6 | 0.50 ± 0.05 | 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

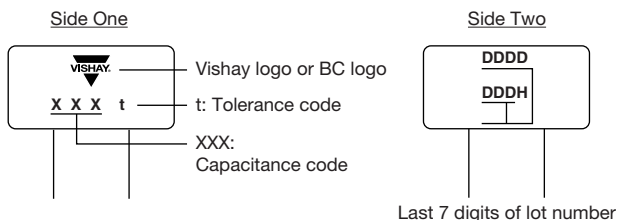
- Bulk packed types have a standard lead length L = 30 mm ± 5 mm
- L2 and H5 are preferred styles

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 |
| 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 _{DC} H = 100 V _{DC} K = 200 V _{DC} | 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 K = outside crimp | 2 = 2.5 mm 5 = 5.0 mm | H = high operating temperature |



ORDERING CODES

| DIELECTRIC C0G | | | |
|----------------|--------------------|---------------------|---------------------|
| CAP. (pF) | 50 V _{DC} | 100 V _{DC} | 200 V _{DC} |
| 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 | - |

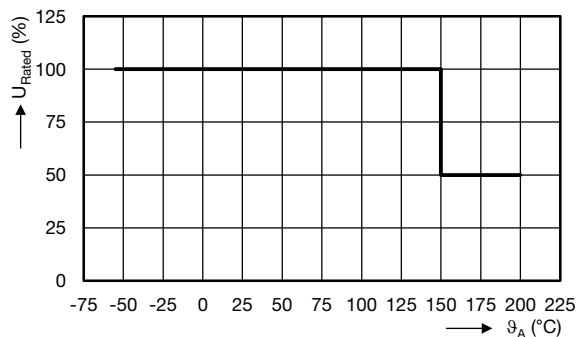
| DIELECTRIC X0U | | | |
|----------------|--------------------|---------------------|---------------------|
| CAP. (pF) | 50 V _{DC} | 100 V _{DC} | 200 V _{DC} |
| 10 000 | K103#15X0UF5###H | K103#15X0UH5###H | K103#15X0UK5###H |
| 15 000 | K153#15X0UF5###H | K153#15X0UH5###H | K153#15X0UK5###H |
| 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

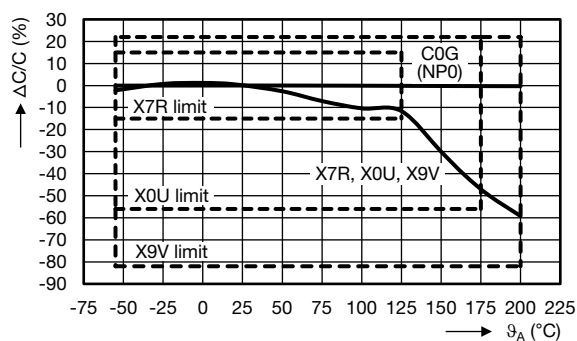
- Lead diameter is 0.5 mm or 0.6 mm
- # 5th digit is capacitance tolerance code: $\pm 5\%$ = J; $\pm 10\%$ = K; $\pm 20\%$ = M
- # 13th digit is packaging code: Bulk = 3; Reel = T; Ammo = U
- # 14th digit is lead style code: L; H; K (L and H are preferred lead configuration)
- # 15th digit is lead spacing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



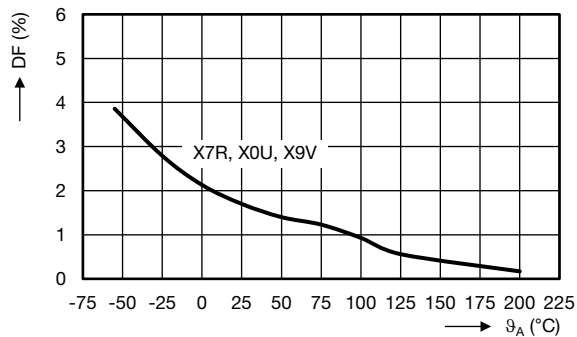
RATED VOLTAGE VS. TEMPERATURE (Typical)



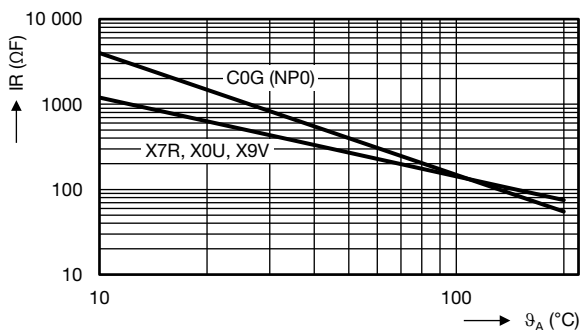
CAPACITANCE CHANGE VS. TEMPERATURE (Typical)



DISSIPATION FACTOR VS. TEMPERATURE (Typical)



INSULATION RESISTANCE VS. TEMPERATURE (Typical)



TAPING AND PACKAGING

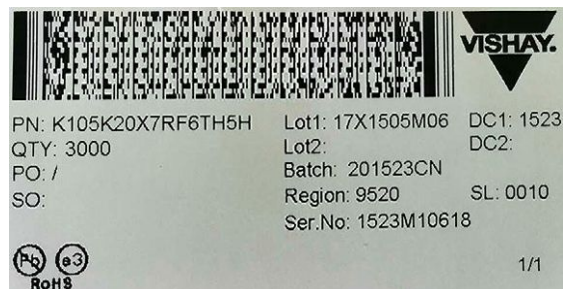
LABELLING

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:



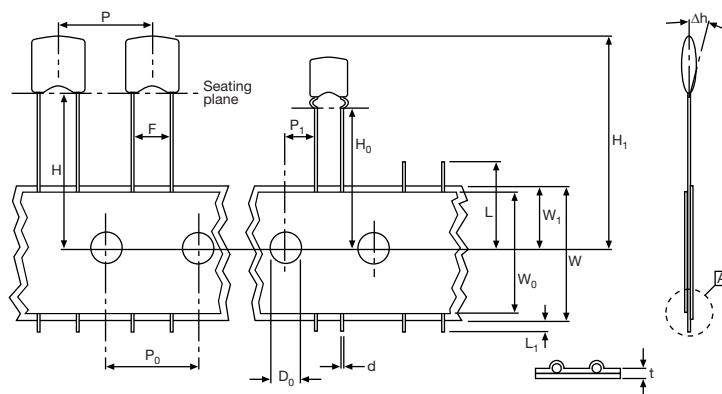
PACKAGING QUANTITIES AND BOX DIMENSIONS

| 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 ⁽¹⁾ | 15, 20 | 5000 | 245 x 120 x 65 |

Note

⁽¹⁾ 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 ₁ | ≤ 1 | ≤ 0.039 |
| Height to seating plane (straight leads) | H | ≥ 18 | ≥ 0.709 |
| Height to seating plane (crimp leads) | H ₀ | 16.0 ± 0.5 | 0.630 ± 0.020 |
| Top of component height | H ₁ | ≤ 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 ₀ | 15.0 REF. | 0.591 REF. |
| Sprocket hole position | W ₁ | 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 ₀ | 12.70 ± 0.30 | 0.500 ± 0.012 |
| Sprocket hole center to lead center at F = 2.5 mm | P ₁ | 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 ₀ | 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 |
| Taping pitch | P | 12.7 REF. | 0.50 REF. |

REEL DATA

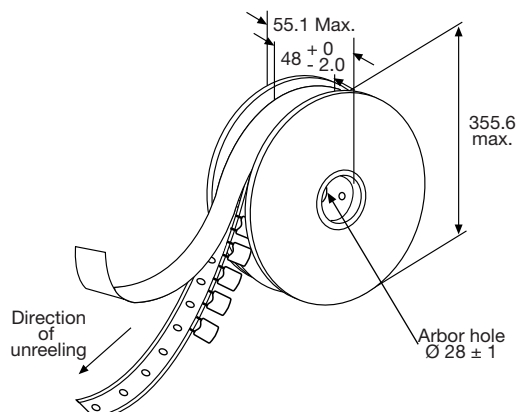
A maximum of 0.5 % of the total number of capacitors per reel may be missing.

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

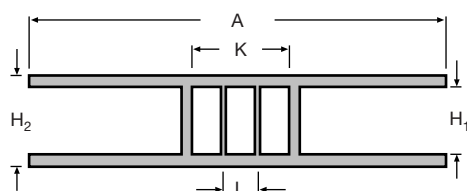
Tape begins and ends with a minimum of 4 empty positions (50 mm tape).

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 ₁ | Internal width | 48 +0/-2 |
| H ₂ | 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.

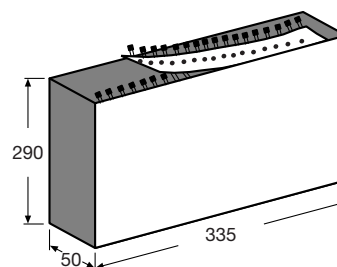
Tape begins and ends with a minimum of 4 empty positions (50 mm tape).

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

SAMPLE KIT

| | |
|-------------|--|
| Part Number | HOTC-KIT-KH |
| Link | www.vishay.com/doc?45234 |



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