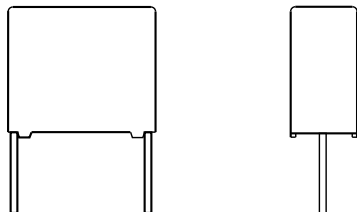


# Interference Suppression Film Capacitor - Class X2

## Radial MKP 310 V<sub>AC</sub> - Standard Across the Line



### FEATURES

- Compliant with IEC 60381-14: AMD1 THB grade IA
- Self-healing properties
- For temperature up to 110 °C
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

### APPLICATIONS

For standard across the line X2 applications.

See also application note: [www.vishay.com/doc?28153](http://www.vishay.com/doc?28153)

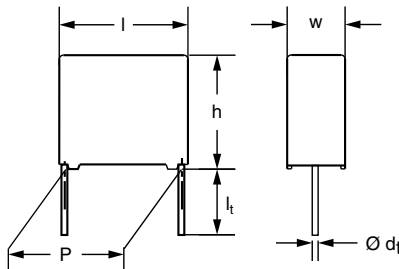
### QUICK REFERENCE DATA

|                                                 |                                                                                                                                                                                             |
|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Capacitance range (E12 series)                  | 0.001 µF to 4.7 µF<br>(preferred values acc. to E6)                                                                                                                                         |
| Capacitance tolerance                           | ± 20 %; ± 10 %; (± 5 % on request)                                                                                                                                                          |
| Rated AC voltage                                | 310 V <sub>AC</sub> ; 50 Hz to 60 Hz                                                                                                                                                        |
| Permissible DC voltage                          | 800 V <sub>DC</sub> at 85 °C<br>630 V <sub>DC</sub> at 110 °C                                                                                                                               |
| Climatic testing class according to IEC 60068-1 | 55 / 110 / 56 / B for volumes > 1750 mm <sup>3</sup><br>55 / 110 / 56 / C for volumes ≤ 1750 mm <sup>3</sup>                                                                                |
| Maximum application temperature                 | C ≤ 470 nF: 110 °C (125 °C for less than 1000 h)<br>C > 470 nF: 110 °C                                                                                                                      |
| Reference standards                             | IEC 60384-14:2013<br>IEC 60384-14:2013 / AMD1:2016<br>EN 60384-14:2013 + AMD1:2016<br>IEC 60065, pass. flamm. class B for volumes > 1750 mm <sup>3</sup><br>CSA-E384-14; CQC<br>UL 60384-14 |
| Dielectric                                      | Polypropylene film                                                                                                                                                                          |
| Electrodes                                      | Metallized film                                                                                                                                                                             |
| Construction                                    | Mono construction                                                                                                                                                                           |
| Encapsulation                                   | Plastic case, epoxy resin sealed, flame retardant class UL 94 V-0                                                                                                                           |
| Leads                                           | Tinned wire                                                                                                                                                                                 |
| Marking                                         | C-value; tolerance; rated voltage; sub-class; manufacturer's type;<br>code for dielectric material; manufacturer location, year and week;<br>manufacturer's logo or name; safety approvals  |

### Notes

- For more detailed data and test requirements, contact [rfi@vishay.com](mailto:rfi@vishay.com)

### DIMENSIONS in millimeters



**COMPOSITION OF CATALOG NUMBER**

The new RFI Film Capacitor Code is made up 14 digit code (example)

| CAPACITANCE SERIES                       |                                                                                                                                                       |   |   |   | CAPACITANCE TOLERANCE                                                                                                                                                                                      |                                                                                       |   |   | PITCH                                                                                                 |                                                                                                                                                                                                                                                                                            | DESIGN LEAD CONFIGURATION POSITION 12, 13, 14                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |                                                                            |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---|---|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----------------------------------------------------------------------------|
| MULTIPLIER AND CAPACITANCE (NUMERICALLY) |                                                                                                                                                       |   |   |   | VOLTAGES                                                                                                                                                                                                   |                                                                                       |   |   |                                                                                                       |                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |    |                                                                            |
| 1                                        | 2                                                                                                                                                     | 3 | 4 | 5 | 6                                                                                                                                                                                                          | 7                                                                                     | 8 | 9 | 10                                                                                                    | 11                                                                                                                                                                                                                                                                                         | 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 13 | 14                                                                         |
| F                                        | 1                                                                                                                                                     | 7 | 7 | 8 | 4                                                                                                                                                                                                          | 1                                                                                     | 0 | M | 2                                                                                                     | F                                                                                                                                                                                                                                                                                          | C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | B  | 0                                                                          |
| 1                                        | 2                                                                                                                                                     | 3 | 4 | 5 | 6                                                                                                                                                                                                          | 7                                                                                     | 8 | 9 | 10                                                                                                    | 11                                                                                                                                                                                                                                                                                         | 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 13 | 14 (POS.)                                                                  |
| F                                        | 1                                                                                                                                                     | 7 | 7 | 8 | 4                                                                                                                                                                                                          | 1                                                                                     | 0 | M | 2                                                                                                     | F                                                                                                                                                                                                                                                                                          | C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | B  | 0                                                                          |
| Capacitance Series                       | Capacitance Value expressed in pF                                                                                                                     |   |   |   | Capacitance Tolerance                                                                                                                                                                                      | Rated Voltage or special versions                                                     |   |   | Pitch                                                                                                 | Design (lead configuration) Pos. 12/13/14                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |    |                                                                            |
| Pos. 1 to 5                              | Pos. 6/7/8                                                                                                                                            |   |   |   | Pos. 9                                                                                                                                                                                                     | Pos. 10                                                                               |   |   | Pos. 11                                                                                               | Pos. 12                                                                                                                                                                                                                                                                                    | Pos. 13                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |    | Pos. 14                                                                    |
|                                          | represent significant figures<br><br>Pos. 6 specifies multiplier (in 10)<br><br>e.g.:<br>0.01 $\mu$ F = 310<br>0.1 $\mu$ F = 410<br>1.0 $\mu$ F = 510 |   |   |   | e.g. 0 (zero) = placeholder<br><br>M = $\pm 20\%$<br>K = $\pm 10\%$<br>J = $\pm 5\%$<br><br>Specials:<br>A = $+10\%/-0\%$<br>B = $+5\%/+15\%$<br>P = $+0\%/-15\%$<br>R = $+10\%/-5\%$<br>U = $+10\%/+20\%$ | e.g. 0 (zero) = placeholder<br><br>2 = 310 V <sub>AC</sub><br>3 = 310 V <sub>AC</sub> |   |   | e.g. 0 (zero) = placeholder<br>C = 7.5 mm<br>D = 10.0 mm<br>F = 15.0 mm<br>I = 22.5 mm<br>K = 27.5 mm | e.g. 0 (zero) = placeholder<br>S = 3.5 - 0.5 mm<br>P = 3.5 $\pm$ 0.3 mm<br>B = 4 - 1 mm<br>M = 5 - 1 mm<br>C = 6 - 1 mm<br>E = 10 - 1 mm<br>T = 11 - 1 mm<br>D = 15 - 1 mm<br>F = 19 - 1 mm<br>H = 20 + 5 mm<br>L = 30 + 5 mm<br>K = 40 + 5 mm<br>N = 45 - 2 mm<br>other = special version | Packaging of specialties<br>0 (zero) = placeholder<br>B = bulk/loose<br>T = tray/pallet <sup>(2)</sup><br>U = tape and reel <sup>(1)</sup><br>(H: 16.5 mm, Ø 350 mm)<br>R = tape and reel <sup>(1)</sup><br>(H: 16.5 mm, Ø 500 mm)<br>V = tape and reel <sup>(1)</sup><br>(H: 18.5 mm, Ø 350 mm)<br>W = tape and reel <sup>(1)</sup><br>(H: 18.5 mm, Ø 500 mm)<br>G = Ammopack <sup>(1)</sup><br>(H: 18.5 mm)<br>Z = leaded wound element<br>(unencapsulated)<br>other = special version |    | Special internal code<br>0 (zero) = placeholder<br>other = special version |

**Notes**

- (1) For detailed tape specification refer to packaging information: [www.vishay.com/doc?28139](http://www.vishay.com/doc?28139)
- (2) Packaging will be bulk for all capacitors with pitch  $\leq 15$  mm and such with long leads ( $> 5$  mm). Capacitors with short leads up to 5 mm and pitch  $> 15$  mm will be in tray and asking code will be "T".



## SPECIFIC REFERENCE DATA

| DESCRIPTION                                                                                       | VALUE                            |                          |
|---------------------------------------------------------------------------------------------------|----------------------------------|--------------------------|
| Rated AC voltage ( $U_{RAC}$ )                                                                    | 310 V                            |                          |
| Permissible DC voltage ( $U_{RDC}$ )                                                              | 630 V                            |                          |
| Tangent of loss angle:                                                                            | at 1 kHz                         | at 10 kHz                |
| $C < 470 \text{ nF}$                                                                              | $\leq 10 \times 10^{-4}$         | $\leq 20 \times 10^{-4}$ |
| $470 \text{ nF} \leq C \leq 1 \text{ }\mu\text{F}$                                                | $\leq 20 \times 10^{-4}$         | $\leq 70 \times 10^{-4}$ |
| $C > 1 \text{ }\mu\text{F}$                                                                       | $\leq 30 \times 10^{-4}$         | -                        |
| Rated voltage pulse slope ( $dU/dt$ ) <sub>R</sub> at 435 V <sub>DC</sub>                         | 600 V/ $\mu$ s                   |                          |
| Pitch = 7.5 mm                                                                                    | 600 V/ $\mu$ s                   |                          |
| Pitch = 10 mm                                                                                     | 400 V/ $\mu$ s                   |                          |
| Pitch = 15 mm                                                                                     | 150 V/ $\mu$ s                   |                          |
| Pitch = 22.5 mm                                                                                   | 100 V/ $\mu$ s                   |                          |
| Pitch = 27.5 mm                                                                                   | > 15 000 M $\Omega$              |                          |
| R between leads, for $C \leq 0.33 \text{ }\mu\text{F}$ at 100 V; 1 min                            | > 5000 s                         |                          |
| RC between leads, for $C > 0.33 \text{ }\mu\text{F}$ at 100 V; 1 min                              | > 30 000 M $\Omega$              |                          |
| R between leads and case; 100 V; 1 min                                                            | 2200 V; 1 min                    |                          |
| Withstanding (DC) voltage (cut off current 10 mA) <sup>(1)</sup> ; rise time 1000 $\leq$ V/s:     | 1800 V; 1 min                    |                          |
| $C \leq 1 \text{ }\mu\text{F}$                                                                    | 2120 V; 1 min                    |                          |
| $C > 1 \text{ }\mu\text{F}$                                                                       | 110 °C (125 °C less than 1000 h) |                          |
| Withstanding (AC) voltage between leads and case                                                  | 110 °C                           |                          |
| Max. application temperature for $0.001 \text{ }\mu\text{F} \leq C \leq 0.47 \text{ }\mu\text{F}$ |                                  |                          |
| Max. application temperature for $C > 0.47 \text{ }\mu\text{F}$                                   |                                  |                          |

## Note

<sup>(1)</sup> See "Voltage Proof Test for Metallized Film Capacitors": [www.vishay.com/doc?28169](http://www.vishay.com/doc?28169)

## ELECTRICAL DATA AND ORDERING CODE

| U <sub>RAC</sub><br>(V) | CAP.<br>μF<br>POS. 6 TO 8                                 | TOLERANCE<br>CODE<br>POS. 9<br>J = ± 5 %<br>K = ± 10 %<br>M = ± 20 % | DIMENSIONS<br>MAX.<br>w x h x l<br>(mm) | MASS<br>(g) <sup>(3)</sup> | SPQ <sup>(4)</sup><br>SHORT<br>LEADS<br>(PIECES) | ORDERING CODE <sup>(2)</sup> |         |      |         |       |                          |
|-------------------------|-----------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------|----------------------------|--------------------------------------------------|------------------------------|---------|------|---------|-------|--------------------------|
|                         |                                                           |                                                                      |                                         |                            |                                                  | TYPE                         | C-VALUE | TOL. | VOLTAGE | PITCH | LEAD<br>LENGTH<br>DESIGN |
|                         |                                                           |                                                                      |                                         |                            |                                                  | 1 TO 5                       | 6 TO 8  | 9    | 10      | 11    | 12 TO 14 <sup>(1)</sup>  |
| 310                     | PITCH 7.5 mm ± 0.4 mm; d <sub>t</sub> = 0.50 mm ± 0.05 mm |                                                                      |                                         |                            |                                                  |                              |         |      |         |       |                          |
|                         | 0.0010                                                    | K / M                                                                | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 210     | .    | .       | C     | .. 0                     |
|                         | 0.0012                                                    | K                                                                    | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 212     | K    | .       | C     | .. 0                     |
|                         | 0.0015                                                    | K / M                                                                | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 215     | .    | .       | C     | .. 0                     |
|                         | 0.0018                                                    | K                                                                    | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 218     | K    | .       | C     | .. 0                     |
|                         | 0.0022                                                    | K / M                                                                | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 222     | .    | .       | C     | .. 0                     |
|                         | 0.0027                                                    | K                                                                    | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 227     | K    | .       | C     | .. 0                     |
|                         | 0.0033                                                    | K / M                                                                | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 233     | .    | .       | C     | .. 0                     |
|                         | 0.0039                                                    | K                                                                    | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 239     | K    | .       | C     | .. 0                     |
|                         | 0.0047                                                    | K / M                                                                | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 247     | .    | .       | C     | .. 0                     |
|                         | 0.0056                                                    | K                                                                    | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 256     | K    | .       | C     | .. 0                     |
|                         | 0.0068                                                    | K / M                                                                | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 268     | .    | .       | C     | .. 0                     |
|                         | 0.0082                                                    | K                                                                    | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 282     | K    | .       | C     | .. 0                     |
|                         | 0.010                                                     | K / M                                                                | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 310     | .    | .       | C     | .. 0                     |
|                         | 0.012                                                     | K                                                                    | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 312     | K    | .       | C     | .. 0                     |
|                         | 0.015                                                     | K / M                                                                | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 315     | .    | .       | C     | .. 0                     |
|                         | 0.018                                                     | K                                                                    | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 318     | K    | .       | C     | .. 0                     |
|                         | 0.022                                                     | K / M                                                                | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 322     | .    | .       | C     | .. 0                     |
|                         | 0.027                                                     | K                                                                    | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 327     | K    | .       | C     | .. 0                     |
|                         | 0.033                                                     | K                                                                    | 5.0 x 10.5 x 10.0                       | 0.6                        | 1000                                             | F1778                        | 333     | K    | .       | C     | .. 0                     |
|                         | 0.033                                                     | M                                                                    | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500                                             | F1778                        | 333     | M    | .       | C     | .. 0                     |
|                         | 0.039                                                     | K                                                                    | 5.0 x 10.5 x 10.0                       | 0.6                        | 1000                                             | F1778                        | 339     | K    | .       | C     | .. 0                     |
|                         | 0.047                                                     | K                                                                    | 5.0 x 10.5 x 10.0                       | 0.6                        | 1000                                             | F1778                        | 347     | K    | .       | C     | .. 0                     |
|                         | 0.047                                                     | M                                                                    | 5.0 x 10.5 x 10.0                       | 0.4                        | 1000                                             | F1778                        | 347     | M    | .       | C     | .. 0                     |
|                         | 0.056                                                     | K                                                                    | 6.0 x 11.5 x 10.0                       | 0.8                        | 750                                              | F1778                        | 356     | K    | .       | C     | .. 0                     |
|                         | 0.068                                                     | M                                                                    | 6.0 x 11.5 x 10.0                       | 0.8                        | 750                                              | F1778                        | 368     | M    | .       | C     | .. 0                     |



## ELECTRICAL DATA AND ORDERING CODE

| U <sub>RAC</sub><br>(V) | CAP.<br>μF<br>POS. 6 TO 8                                | TOLERANCE<br>CODE<br>POS. 9<br>J = ± 5 %<br>K = ± 10 %<br>M = ± 20 % | DIMENSIONS<br>MAX.<br>w x h x l<br>(mm) | MASS<br>(g) <sup>(3)</sup> | SPQ <sup>(4)</sup><br>SHORT<br>LEADS<br>(PIECES) | ORDERING CODE <sup>(2)</sup> |         |      |         |       |                          |
|-------------------------|----------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------|----------------------------|--------------------------------------------------|------------------------------|---------|------|---------|-------|--------------------------|
|                         |                                                          |                                                                      |                                         |                            |                                                  | TYPE                         | C-VALUE | TOL. | VOLTAGE | PITCH | LEAD<br>LENGTH<br>DESIGN |
|                         |                                                          |                                                                      |                                         |                            |                                                  | 1 TO 5                       | 6 TO 8  | 9    | 10      | 11    | 12 TO 14 <sup>(1)</sup>  |
| 310                     | PITCH 10 mm ± 0.4 mm; d <sub>t</sub> = 0.60 mm ± 0.06 mm |                                                                      |                                         |                            |                                                  |                              |         |      |         |       |                          |
|                         | 0.0010                                                   | K / M                                                                | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 210     | .    | .       | D     | ..0                      |
|                         | 0.0012                                                   | K                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 212     | K    | .       | D     | ..0                      |
|                         | 0.0015                                                   | K / M                                                                | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 215     | .    | .       | D     | ..0                      |
|                         | 0.0018                                                   | K                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 218     | K    | .       | D     | ..0                      |
|                         | 0.0022                                                   | K / M                                                                | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 222     | .    | .       | D     | ..0                      |
|                         | 0.0027                                                   | K                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 227     | K    | .       | D     | ..0                      |
|                         | 0.0033                                                   | K / M                                                                | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 233     | .    | .       | D     | ..0                      |
|                         | 0.0039                                                   | K                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 239     | K    | .       | D     | ..0                      |
|                         | 0.0047                                                   | K / M                                                                | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 247     | .    | .       | D     | ..0                      |
|                         | 0.0056                                                   | K                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 256     | K    | .       | D     | ..0                      |
|                         | 0.0068                                                   | K / M                                                                | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 268     | .    | .       | D     | ..0                      |
|                         | 0.0082                                                   | K                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 282     | K    | .       | D     | ..0                      |
|                         | 0.010                                                    | K / M                                                                | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 310     | .    | .       | D     | ..0                      |
|                         | 0.012                                                    | K                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 312     | K    | .       | D     | ..0                      |
|                         | 0.015                                                    | K / M                                                                | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500                                             | F1778                        | 315     | .    | .       | D     | ..0                      |
|                         | 0.018                                                    | K                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 1250                                             | F1778                        | 318     | K    | .       | D     | ..0                      |
|                         | 0.022                                                    | K / M                                                                | 4.0 x 10.0 x 12.5                       | 0.6                        | 1250                                             | F1778                        | 322     | .    | .       | D     | ..0                      |
|                         | 0.027                                                    | K                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 1250                                             | F1778                        | 327     | K    | .       | D     | ..0                      |
|                         | 0.033                                                    | K / M                                                                | 4.0 x 10.0 x 12.5                       | 0.6                        | 1000                                             | F1778                        | 333     | .    | .       | D     | ..0                      |
|                         | 0.039                                                    | K                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 1000                                             | F1778                        | 339     | K    | .       | D     | ..0                      |
|                         | 0.047                                                    | K                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 750                                              | F1778                        | 347     | K    | .       | D     | ..0                      |
|                         | 0.047                                                    | M                                                                    | 4.0 x 10.0 x 12.5                       | 0.6                        | 1000                                             | F1778                        | 347     | M    | .       | D     | ..0                      |
|                         | 0.056                                                    | K                                                                    | 5.0 x 11.0 x 12.5                       | 0.82                       | 1000                                             | F1778                        | 356     | K    | .       | D     | ..0                      |
|                         | 0.068                                                    | K / M                                                                | 5.0 x 11.0 x 12.5                       | 0.82                       | 750                                              | F1778                        | 368     | .    | .       | D     | ..0                      |
|                         | 0.082                                                    | K                                                                    | 6.0 x 12.0 x 12.5                       | 1.10                       | 750                                              | F1778                        | 382     | K    | .       | D     | ..0                      |
|                         | 0.100                                                    | K / M                                                                | 6.0 x 12.0 x 12.5                       | 1.10                       | 750                                              | F1778                        | 410     | .    | .       | D     | ..0                      |
|                         | PITCH 15 mm ± 0.4 mm; d <sub>t</sub> = 0.60 mm ± 0.06 mm |                                                                      |                                         |                            |                                                  |                              |         |      |         |       |                          |
|                         | 0.010                                                    | K / M                                                                | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 310     | .    | .       | F     | ..0                      |
|                         | 0.012                                                    | K                                                                    | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 312     | K    | .       | F     | ..0                      |
|                         | 0.015                                                    | K / M                                                                | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 315     | .    | .       | F     | ..0                      |
|                         | 0.018                                                    | K                                                                    | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 318     | K    | .       | F     | ..0                      |
|                         | 0.022                                                    | K / M                                                                | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 322     | .    | .       | F     | ..0                      |
|                         | 0.027                                                    | K                                                                    | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 327     | K    | .       | F     | ..0                      |
|                         | 0.033                                                    | K / M                                                                | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 333     | .    | .       | F     | ..0                      |
|                         | 0.039                                                    | K                                                                    | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 339     | K    | .       | F     | ..0                      |
|                         | 0.047                                                    | K / M                                                                | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 347     | .    | .       | F     | ..0                      |
|                         | 0.056                                                    | K                                                                    | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 356     | K    | .       | F     | ..0                      |
|                         | 0.068                                                    | K / M                                                                | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 368     | .    | .       | F     | ..0                      |
|                         | 0.082                                                    | K                                                                    | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 382     | K    | .       | F     | ..0                      |
|                         | 0.10                                                     | K                                                                    | 5.0 x 11.0 x 17.5                       | 1.0                        | 600                                              | F1778                        | 410     | K    | .       | F     | ..0                      |
|                         | 0.10                                                     | M                                                                    | 5.0 x 11.0 x 17.5                       | 1.0                        | 750                                              | F1778                        | 410     | M    | .       | F     | ..0                      |
|                         | 0.12                                                     | K                                                                    | 6.0 x 12.0 x 17.5                       | 1.4                        | 600                                              | F1778                        | 412     | K    | .       | F     | ..0                      |
|                         | 0.15                                                     | K                                                                    | 6.0 x 12.0 x 17.5                       | 1.4                        | 450                                              | F1778                        | 415     | K    | .       | F     | ..0                      |
|                         | 0.15                                                     | M                                                                    | 6.0 x 12.0 x 17.5                       | 1.4                        | 600                                              | F1778                        | 415     | M    | .       | F     | ..0                      |
|                         | PITCH 15 mm ± 0.4 mm; d <sub>t</sub> = 0.80 mm ± 0.08 mm |                                                                      |                                         |                            |                                                  |                              |         |      |         |       |                          |
|                         | 0.18                                                     | K                                                                    | 7.0 x 13.5 x 17.5                       | 1.8                        | 450                                              | F1778                        | 418     | K    | .       | F     | ..0                      |
|                         | 0.22                                                     | K / M                                                                | 7.0 x 13.5 x 17.5                       | 1.8                        | 300                                              | F1778                        | 422     | .    | .       | F     | ..0                      |
|                         | 0.27                                                     | K                                                                    | 8.5 x 15.0 x 17.5                       | 2.4                        | 240                                              | F1778                        | 427     | K    | .       | F     | ..0                      |
|                         | 0.33                                                     | K / M                                                                | 8.5 x 15.0 x 17.5                       | 2.4                        | 240                                              | F1778                        | 433     | .    | .       | F     | ..0                      |
|                         | 0.39                                                     | K                                                                    | 10.0 x 16.5 x 17.5                      | 3                          | 225                                              | F1778                        | 439     | K    | .       | F     | ..0                      |
|                         | 0.47                                                     | K / M                                                                | 10.0 x 16.5 x 17.5                      | 3                          | 225                                              | F1778                        | 447     | .    | .       | F     | ..0                      |
|                         | 0.56                                                     | K / M                                                                | 10.0 x 18.5 x 18.0                      | 4.3                        | 225                                              | F1778                        | 456     | .    | .       | F     | ..0                      |
|                         | 0.68                                                     | M                                                                    | 11.0 x 18.5 x 18.0                      | 5.5                        | 225                                              | F1778                        | 468     | M    | .       | F     | ..0                      |



## ELECTRICAL DATA AND ORDERING CODE

| U <sub>RAC</sub><br>(V) | CAP.<br>μF<br>POS. 6 TO 8                                  | TOLERANCE<br>CODE<br>POS. 9<br>J = ± 5 %<br>K = ± 10 %<br>M = ± 20 % | DIMENSIONS<br>MAX.<br>w x h x l<br>(mm) | MASS<br>(g) <sup>(3)</sup> | SPQ <sup>(4)</sup><br>SHORT<br>LEADS<br>(PIECES) | ORDERING CODE <sup>(2)</sup> |         |      |         |       |                          |
|-------------------------|------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------|----------------------------|--------------------------------------------------|------------------------------|---------|------|---------|-------|--------------------------|
|                         |                                                            |                                                                      |                                         |                            |                                                  | TYPE                         | C-VALUE | TOL. | VOLTAGE | PITCH | LEAD<br>LENGTH<br>DESIGN |
|                         |                                                            |                                                                      |                                         |                            |                                                  | 1 TO 5                       | 6 TO 8  | 9    | 10      | 11    | 12 TO 14 <sup>(1)</sup>  |
| 310                     | PITCH 22.5 mm ± 0.4 mm; d <sub>t</sub> = 0.80 mm ± 0.08 mm |                                                                      |                                         |                            |                                                  |                              |         |      |         |       |                          |
|                         | 0.12                                                       | K                                                                    | 6.0 x 15.5 x 26.0                       | 2.4                        | 260                                              | F1778                        | 412     | K    | .       | I     | .. 0                     |
|                         | 0.15                                                       | K / M                                                                | 6.0 x 15.5 x 26.0                       | 2.4                        | 260                                              | F1778                        | 415     | .    | .       | I     | .. 0                     |
|                         | 0.18                                                       | K                                                                    | 6.0 x 15.5 x 26.0                       | 2.4                        | 260                                              | F1778                        | 418     | K    | .       | I     | .. 0                     |
|                         | 0.22                                                       | K / M                                                                | 6.0 x 15.5 x 26.0                       | 2.4                        | 260                                              | F1778                        | 422     | .    | .       | I     | .. 0                     |
|                         | 0.27                                                       | K                                                                    | 6.0 x 15.5 x 26.0                       | 2.4                        | 200                                              | F1778                        | 427     | K    | .       | I     | .. 0                     |
|                         | 0.33                                                       | K                                                                    | 6.0 x 15.5 x 26.0                       | 2.4                        | 190                                              | F1778                        | 433     | K    | .       | I     | .. 0                     |
|                         | 0.33                                                       | M                                                                    | 6.0 x 15.5 x 26.0                       | 2.4                        | 235                                              | F1778                        | 433     | M    | .       | I     | .. 0                     |
|                         | 0.39                                                       | K                                                                    | 7.0 x 16.5 x 26.0                       | 2.9                        | 200                                              | F1778                        | 439     | K    | .       | I     | .. 0                     |
|                         | 0.47                                                       | K                                                                    | 7.0 x 16.5 x 26.0                       | 2.9                        | 190                                              | F1778                        | 447     | K    | .       | I     | .. 0                     |
|                         | 0.47                                                       | M                                                                    | 7.0 x 16.5 x 26.0                       | 2.9                        | 200                                              | F1778                        | 447     | M    | .       | I     | .. 0                     |
|                         | 0.56                                                       | K                                                                    | 8.5 x 18.0 x 26.0                       | 3.8                        | 150                                              | F1778                        | 456     | K    | .       | I     | .. 0                     |
|                         | 0.68                                                       | K                                                                    | 10.0 x 19.5 x 26.0                      | 6.8                        | 150                                              | F1778                        | 468     | K    | .       | I     | .. 0                     |
|                         | 0.68                                                       | M                                                                    | 8.5 x 18.0 x 26.0                       | 3.8                        | 170                                              | F1778                        | 468     | M    | .       | I     | .. 0                     |
|                         | 0.82                                                       | K                                                                    | 10.0 x 19.5 x 26.0                      | 6.8                        | 200                                              | F1778                        | 482     | K    | .       | I     | .. 0                     |
|                         | 1.0                                                        | K                                                                    | 12.0 x 22.0 x 26.0                      | 7.8                        | 150                                              | F1778                        | 510     | K    | .       | I     | .. 0                     |
|                         | 1.0                                                        | M                                                                    | 10.0 x 19.5 x 26.0                      | 6.8                        | 135                                              | F1778                        | 510     | M    | .       | I     | .. 0                     |
|                         | 1.5                                                        | M                                                                    | 12.5 x 22.5 x 26.5                      | 10                         | 140                                              | F1778                        | 515     | M    | .       | I     | .. 0                     |
|                         | PITCH 27.5 mm ± 0.4 mm; d <sub>t</sub> = 0.80 mm ± 0.08 mm |                                                                      |                                         |                            |                                                  |                              |         |      |         |       |                          |
|                         | 0.47                                                       | K / M                                                                | 9.0 x 19.0 x 31.5                       | 5.5                        | 160                                              | F1778                        | 447     | .    | .       | K     | .. 0                     |
|                         | 0.56                                                       | K                                                                    | 9.0 x 19.0 x 31.5                       | 5.5                        | 160                                              | F1778                        | 456     | K    | .       | K     | .. 0                     |
|                         | 0.68                                                       | K / M                                                                | 9.0 x 19.0 x 31.5                       | 5.5                        | 160                                              | F1778                        | 468     | .    | .       | K     | .. 0                     |
|                         | 0.82                                                       | K                                                                    | 11.0 x 21.0 x 31.0                      | 7.4                        | 125                                              | F1778                        | 482     | K    | .       | K     | .. 0                     |
|                         | 1.0                                                        | K / M                                                                | 11.0 x 21.0 x 31.0                      | 7.4                        | 125                                              | F1778                        | 510     | .    | .       | K     | .. 0                     |
|                         | 1.2                                                        | K                                                                    | 11.0 x 21.0 x 31.0                      | 7.4                        | 110                                              | F1778                        | 512     | K    | .       | K     | .. 0                     |
|                         | 1.5                                                        | K / M                                                                | 13.0 x 23.0 x 31.0                      | 9.2                        | 110                                              | F1778                        | 515     | .    | .       | K     | .. 0                     |
|                         | 1.8                                                        | K                                                                    | 15.0 x 25.0 x 31.5                      | 12.3                       | 85                                               | F1778                        | 518     | K    | .       | K     | .. 0                     |
|                         | 2.2                                                        | K / M                                                                | 15.0 x 25.0 x 31.5                      | 12.3                       | 85                                               | F1778                        | 522     | .    | .       | K     | .. 0                     |
|                         | 2.7                                                        | K                                                                    | 18.0 x 28.0 x 31.5                      | 16.1                       | 100                                              | F1778                        | 527     | K    | .       | K     | .. 0                     |
|                         | 3.3                                                        | K                                                                    | 21.0 x 31.0 x 31.0                      | 20.3                       | 70                                               | F1778                        | 533     | K    | .       | K     | .. 0                     |
|                         | 3.3                                                        | M                                                                    | 18.0 x 28.0 x 31.5                      | 16.1                       | 80                                               | F1778                        | 533     | M    | .       | K     | .. 0                     |
|                         | 3.9                                                        | K                                                                    | 21.0 x 31.0 x 31.0                      | 20.3                       | 50                                               | F1778                        | 539     | K    | .       | K     | .. 0                     |
|                         | 4.7                                                        | M                                                                    | 21.0 x 31.0 x 31.0                      | 20.3                       | 50                                               | F1778                        | 547     | M    | .       | K     | .. 0                     |

## Notes

- SPQ = Standard Packing Quantity
- For detailed tape specifications refer to packaging information: [www.vishay.com/doc?28139](http://www.vishay.com/doc?28139)
- <sup>(1)</sup> For further packaging see table "Composition of Catalog Number"
- <sup>(2)</sup> Further information about packaging quantities with different lead length and / or taped versions, see document "Packing Quantities" [www.vishay.com/doc?27608](http://www.vishay.com/doc?27608)
- <sup>(3)</sup> Weight for short lead product only

| APPROVALS                                                                                                                                                                                                                                                                                                                                                          |                     |                |                       |                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------|-----------------------|------------------------------------------------------------------------|
| SAFETY APPROVALS X2                                                                                                                                                                                                                                                                                                                                                | VOLTAGE             | VALUE          | FILE NUMBERS          | LINKS                                                                  |
| EN 60384-14 (ENEC)<br>(= IEC 60384-14 ed-4 (2013))                                                                                                                                                                                                                                                                                                                 | 310 V <sub>AC</sub> | 1 nF to 4.7 µF | ENEC16/FI/21/01054/A2 | <a href="http://www.vishay.com/doc?28179">www.vishay.com/doc?28179</a> |
| UL 60384-14                                                                                                                                                                                                                                                                                                                                                        | 310 V <sub>AC</sub> | 1 nF to 4.7 µF | E354331               | <a href="http://www.vishay.com/doc?28184">www.vishay.com/doc?28184</a> |
| CSA-E384-14                                                                                                                                                                                                                                                                                                                                                        | 310 V <sub>AC</sub> | 1 nF to 4.7 µF | E354331               |                                                                        |
| CQC                                                                                                                                                                                                                                                                                                                                                                | 310 V <sub>AC</sub> | 1 nF to 4.7 µF | CQC08001026060 (F)    | <a href="http://www.vishay.com/doc?27624">www.vishay.com/doc?27624</a> |
|                                                                                                                                                                                                                                                                                                                                                                    |                     |                | CQC08001026061 (L)    | <a href="http://www.vishay.com/doc?27625">www.vishay.com/doc?27625</a> |
| CB test certificate                                                                                                                                                                                                                                                                                                                                                | 310 V <sub>AC</sub> | 1 nF to 4.7 µF | FI-39827/A1           | <a href="http://www.vishay.com/doc?28175">www.vishay.com/doc?28175</a> |
| The ENEC-approval together with the CB-certificate replace all national marks of the following countries (they have already signed the ENEC-agreement): Austria; Belgium; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Luxembourg; Netherlands; Norway; Portugal; Slovenian; Spain; Sweden; Switzerland and United Kingdom. |                     |                |                       |                                                                        |
|                                                                                                               |                     |                |                       |                                                                        |

## MOUNTING

### Normal Use

The capacitors are designed for mounting on printed-circuit boards. The capacitors packed in bandoleers are designed for mounting in printed circuit boards by means of automatic insertion machines.

For detailed tape specifications refer to Packaging Information: [www.vishay.com/doc?28139](http://www.vishay.com/doc?28139)

### Specific Method of Mounting to Withstand Vibration and Shock

In order to withstand vibration and shock tests, it must be ensured that the stand-off pips are in good contact with the printed-circuit board:

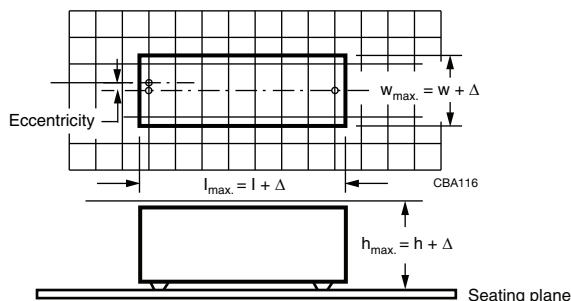
- For pitches  $\leq 15$  mm capacitors shall be mechanically fixed by the leads
- For larger pitches the capacitors shall be mounted in the same way and the body clamped in addition

### Space Requirements on Printed Circuit-Board

The maximum space for length ( $l_{max.}$ ), width ( $w_{max.}$ ), and height ( $h_{max.}$ ) of film capacitors to take in account on the printed circuit board is shown in the drawings:

- For products with pitch  $\leq 15$  mm,  $\Delta w \times \Delta l = 0.3$  mm and  $\Delta h = 0.1$  mm
- For products with  $15 \text{ mm} < \text{pitch} \leq 27.5$  mm,  $\Delta w \times \Delta l = 0.5$  mm and  $\Delta h = 0.1$  mm
- For products with pitch = 37.5 mm,  $\Delta w \times \Delta l = 0.7$  mm and  $\Delta h = 0.5$  mm

Eccentricity defined as in drawing. The maximum eccentricity is smaller than or equal to the lead diameter of the product concerned.



## SOLDERING CONDITIONS

For general soldering conditions and wave soldering profile, we refer to the application note:

"Soldering Guideline for Film Capacitors": [www.vishay.com/doc?28171](http://www.vishay.com/doc?28171)

## Storage Temperature

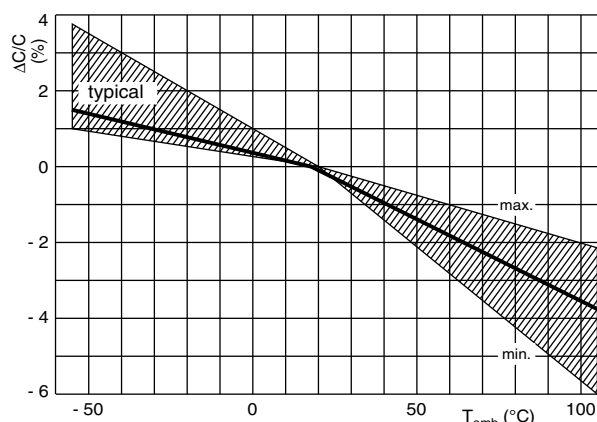
$T_{stg} = -25\text{ }^{\circ}\text{C}$  to  $+35\text{ }^{\circ}\text{C}$  with RH maximum 75 % without condensation

## Ratings and Characteristics Reference Conditions

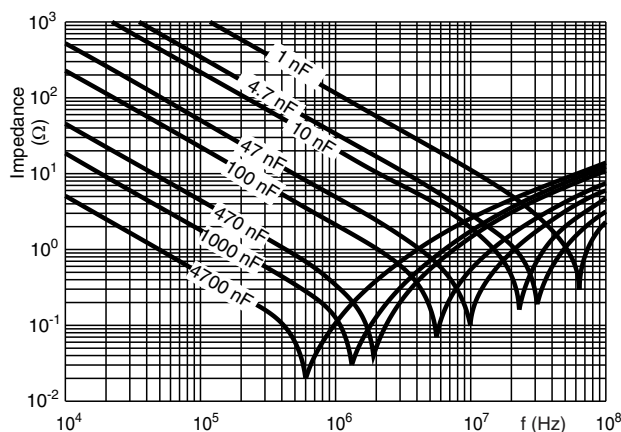
Unless otherwise specified, all electrical values apply to an ambient free air temperature of  $23\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ , an atmospheric pressure of 86 kPa to 106 kPa and a relative humidity of  $50\text{ } \pm 2\text{ } \%$ .

For reference testing, a conditioning period shall be applied over  $96\text{ h} \pm 4\text{ h}$  by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.

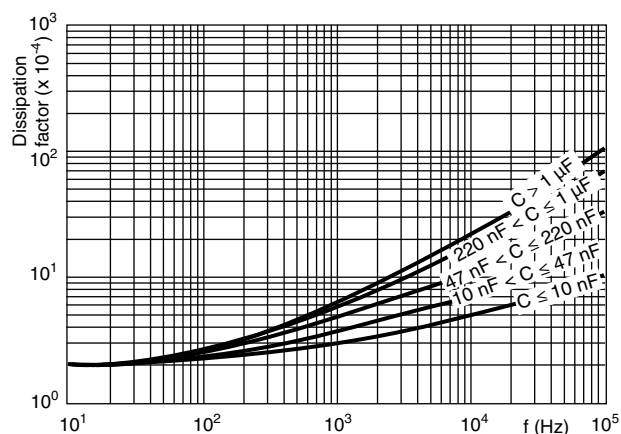
## CHARACTERISTICS



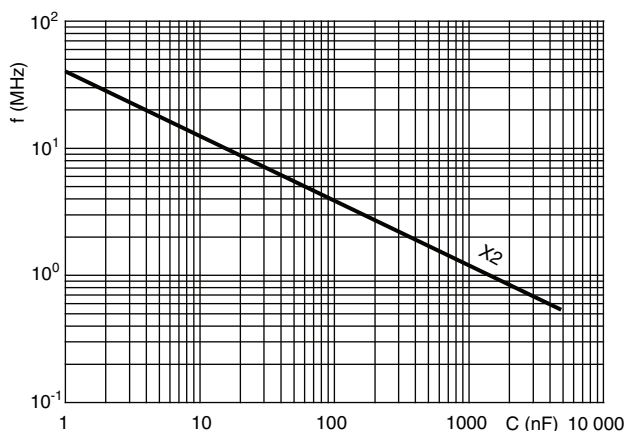
Capacitance as a function of ambient temperature  
(typical curve)



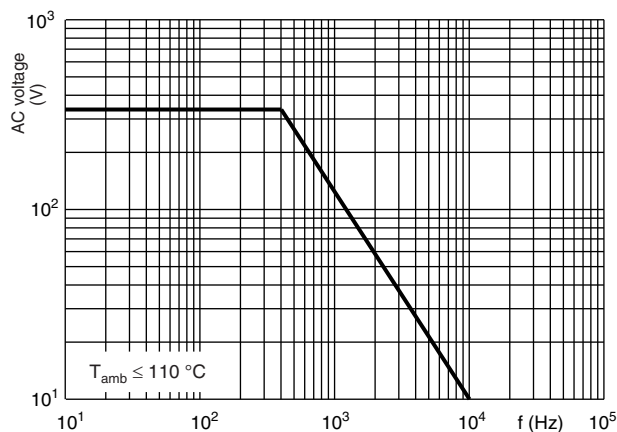
Impedance as a function of frequency  
(typical curve)



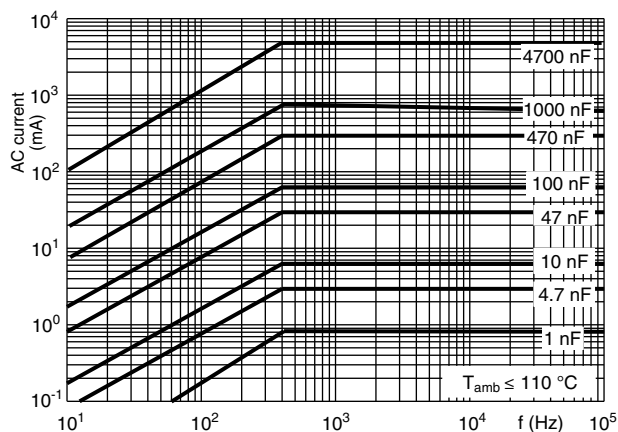
Tangent of loss angle as a function of frequency  
(typical curve)



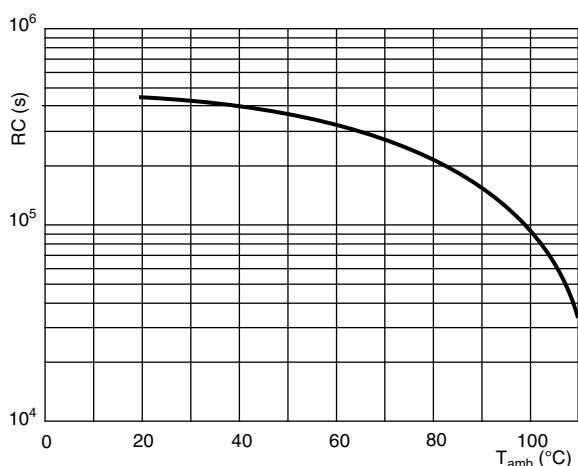
Resonant frequency as a function of capacitance  
(typical curve)



Max. RMS voltage as a function of frequency  
(typical curve)



Max. RMS current as a function of frequency  
(typical curve)



Insulation resistance as a function of ambient temperature  
(typical curve)

## APPLICATION NOTES

- For X2 electromagnetic interference suppression in **standard across the line applications** (50 Hz / 60 Hz) with a maximum mains voltage of 310 V<sub>AC</sub>.
- For series impedance applications we refer to application note [www.vishay.com/doc?28153](http://www.vishay.com/doc?28153)
- For capacitors connected in parallel, normally the proof voltage and possibly the rated voltage must be reduced. For information depending of the capacitance value and the number of parallel connections contact: [rfi@vishay.com](mailto:rfi@vishay.com)
- These capacitors are not intended for continuous pulse applications. For these situations, capacitors of the AC and pulse programs must be used.
- The maximum ambient temperature must not exceed 110 °C (125 °C for less than 1000 h) for C ≤ 470 nF and 110 °C for C > 470 nF.
- Rated voltage pulse slope:  
if the pulse voltage is lower than the rated voltage, the values of the specific reference data can be multiplied by 435 V<sub>DC</sub> and divided by the applied voltage.



**INSPECTION REQUIREMENTS****General Notes**

Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, IEC Publication IEC 60384-14 ed-4 (2013) and Specific Reference Data”.

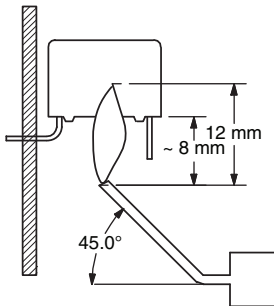
| <b>GROUP C INSPECTION REQUIREMENTS</b>              |                                                                                                                                                                                                                            |                                                                                                                                                               |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>SUB-CLAUSE NUMBER AND TEST</b>                   | <b>CONDITIONS</b>                                                                                                                                                                                                          | <b>PERFORMANCE REQUIREMENTS</b>                                                                                                                               |
| <b>SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1</b> |                                                                                                                                                                                                                            |                                                                                                                                                               |
| 4.1 Dimensions (detail)                             |                                                                                                                                                                                                                            | As specified in section “General Data” of this specification                                                                                                  |
| Initial measurements                                | Capacitance<br>Tangent of loss angle:<br>for $C \leq 1 \mu\text{F}$ at 10 kHz<br>for $C > 1 \mu\text{F}$ at 1 kHz                                                                                                          |                                                                                                                                                               |
| 4.3 Robustness of terminations                      | Tensile: load 10 N; 10 s<br>Bending: load 5 N; 4 x 90°                                                                                                                                                                     | No visible damage                                                                                                                                             |
| 4.4 Resistance to soldering heat                    | No pre-drying<br>Method: 1A<br>Solder bath: 280 °C ± 5 °C<br>Duration: 10 s                                                                                                                                                |                                                                                                                                                               |
| 4.19 Component solvent resistance                   | Isopropylalcohol at room temperature<br>Method: 2<br>Immersion time: 5 min ± 0.5 min<br>Recovery time:<br>min. 1 h, max. 2 h                                                                                               |                                                                                                                                                               |
| 4.4.2 Final measurements                            | Visual examination                                                                                                                                                                                                         | No visible damage<br>Legible marking                                                                                                                          |
|                                                     | Capacitance                                                                                                                                                                                                                | $ \Delta C/C  \leq 5 \%$ of the value measured initially.                                                                                                     |
|                                                     | Tangent of loss angle                                                                                                                                                                                                      | Increase of $\tan \delta$ :<br>$\leq 0.008$ for: $C \leq 1 \mu\text{F}$ or<br>$\leq 0.005$ for: $C > 1 \mu\text{F}$<br>Compared to values measured initially. |
|                                                     | Insulation resistance                                                                                                                                                                                                      | As specified in section “Insulation Resistance” of this specification                                                                                         |
| <b>SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1</b> |                                                                                                                                                                                                                            |                                                                                                                                                               |
| Initial measurements                                | Capacitance<br>Tangent of loss angle:<br>for $C \leq 1 \mu\text{F}$ at 10 kHz<br>for $C > 1 \mu\text{F}$ at 1 kHz                                                                                                          |                                                                                                                                                               |
| 4.20 Solvent resistance of the marking              | Isopropylalcohol at room temperature<br>Method: 1<br>Rubbing material: cotton wool<br>Immersion time: 5 min ± 0.5 min                                                                                                      | No visible damage<br>Legible marking                                                                                                                          |
| 4.6 Rapid change of temperature                     | $\theta A = -55 \text{ °C}$<br>$\theta B = +110 \text{ °C}$<br>5 cycles<br>Duration $t = 30 \text{ min}$                                                                                                                   |                                                                                                                                                               |
| 4.6.1 Inspection                                    | Visual examination                                                                                                                                                                                                         | No visible damage                                                                                                                                             |
| 4.7 Vibration                                       | Mounting: see section “Mounting” of this specification<br>Procedure B4<br>Frequency range: 10 Hz to 55 Hz<br>Amplitude: 0.75 mm or<br>Acceleration 98 m/s <sup>2</sup><br>(whichever is less severe)<br>Total duration 6 h |                                                                                                                                                               |



| GROUP C INSPECTION REQUIREMENTS                                            |                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SUB-CLAUSE NUMBER AND TEST                                                 | CONDITIONS                                                                                                                                                                    | PERFORMANCE REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1</b>                        |                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.7.2 Final inspection                                                     | Visual examination                                                                                                                                                            | No visible damage                                                                                                                                                                                                                                                                                                                                                                                                       |
| 4.9 Shock                                                                  | Mounting: see section "Mounting" for more information<br>Pulse shape: half sine<br>Acceleration: 490 m/s <sup>2</sup><br>Duration of pulse: 11 ms                             |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.9.2 Final measurements                                                   | Visual examination<br><br>Capacitance<br><br>Tangent of loss angle<br><br><br>Insulation resistance                                                                           | No visible damage<br><br>$ \Delta C/C  \leq 5\%$ of the value measured initially.<br><br>Increase of $\tan \delta$ :<br>$\leq 0.008$ for: $C \leq 1\ \mu\text{F}$ or<br>$\leq 0.005$ for: $C > 1\ \mu\text{F}$<br>Compared to values measured initially.<br><br>As specified in section "Insulation Resistance" of this specification                                                                                   |
| <b>SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B</b> |                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.11 Climatic sequence                                                     |                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.11.1 Initial measurements                                                | Capacitance<br>measured in 4.4.2 and 4.9.2<br>Tangent of loss angle:<br>measured initially in C1A and C1B                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.11.2 Dry heat                                                            | Temperature: 110 °C                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.11.3 Damp heat cyclic<br>Test Db<br>First cycle                          | Duration: 16 h                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.11.4 Cold                                                                | Temperature: -55 °C                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.11.5 Damp heat cyclic<br>Test Db<br>Remaining cycles                     | Duration: 2 h                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.11.6 Final measurements                                                  | Visual examination<br><br>Capacitance<br><br>Tangent of loss angle<br><br><br>Voltage proof<br>1350 V <sub>DC</sub> ; 1 min between terminations<br><br>Insulation resistance | No visible damage<br>Legible marking<br><br>$ \Delta C/C  \leq 5\%$ of the value measured in 4.11.1.<br><br>Increase of $\tan \delta$ :<br>$\leq 0.008$ for: $C \leq 1\ \mu\text{F}$ or<br>$\leq 0.005$ for: $C > 1\ \mu\text{F}$<br>Compared to values measured in 4.11.1.<br><br>No permanent breakdown or flash-over<br><br>$\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |
| <b>SUB-GROUP C2</b>                                                        |                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.12 Damp heat steady state                                                | 56 days; 40 °C; 90 % to 95 % RH<br>no load                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.12.1 Initial measurements                                                | Capacitance<br>Tangent of loss angle: at 1 kHz                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.12.3 Final measurements                                                  | Visual examination<br><br>Capacitance                                                                                                                                         | No visible damage<br>Legible marking<br><br>$ \Delta C/C  \leq 5\%$ of the value measured in 4.12.1.                                                                                                                                                                                                                                                                                                                    |



| GROUP C INSPECTION REQUIREMENTS |                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SUB-CLAUSE NUMBER AND TEST      | CONDITIONS                                                                                                                                                                                                                              | PERFORMANCE REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>SUB-GROUP C2</b>             |                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4.12.3 Final measurements       | Tangent of loss angle<br><br>Voltage proof<br>1350 V <sub>DC</sub> ; 1 min between terminations<br><br>Insulation resistance                                                                                                            | Increase of tan $\delta$ :<br>$\leq 0.008$ for: $C \leq 1 \mu\text{F}$ or<br>$\leq 0.005$ for: $C > 1 \mu\text{F}$<br>Compared to values measured in 4.12.1.<br><br>No permanent breakdown or flash-over<br><br>$\geq 50 \%$ of values specified in section<br>"Insulation Resistance" of this specification                                                                                                                     |
| <b>SUB-GROUP C3</b>             |                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4.13.1 Initial measurements     | Capacitance<br>Tangent of loss angle:<br>for $C \leq 1 \mu\text{F}$ at 10 kHz<br>for $C > 1 \mu\text{F}$ at 1 kHz                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4.13 Impulse voltage            | 3 successive impulses, full wave, peak voltage:<br>X2: 2.5 kV for $C \leq 1 \mu\text{F}$<br>X2: 2.5 kV/ $\sqrt{C}$ for $C > 1 \mu\text{F}$<br>Max. 24 pulses                                                                            | No self healing, breakdowns or flash-over                                                                                                                                                                                                                                                                                                                                                                                        |
| 4.14 Endurance                  | Duration: 1000 h<br>1.25 x U <sub>RAC</sub> at 110 °C<br>Once in every hour the voltage is increased to 1000 V <sub>RMS</sub> for 0.1 s via resistor of 47 $\Omega \pm 5 \%$                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4.14.7 Final measurements       | Visual examination<br><br>Capacitance<br><br>Tangent of loss angle<br><br>Voltage proof<br>1350 V <sub>DC</sub> ; 1 min between terminations<br>2120 V <sub>AC</sub> ; 1 min between terminations and case<br><br>Insulation resistance | No visible damage<br>Legible marking<br><br>$ \Delta C/C  \leq 10 \%$ compared to values measured in 4.13.1.<br><br>Increase of tan $\delta$ :<br>$\leq 0.008$ for: $C \leq 1 \mu\text{F}$ or<br>$\leq 0.005$ for: $C > 1 \mu\text{F}$<br>Compared to values measured in 4.13.1.<br><br>No permanent breakdown or flash-over<br><br>$\geq 50 \%$ of values specified in section<br>"Insulation Resistance" of this specification |
| <b>SUB-GROUP C4</b>             |                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4.15 Charge and discharge       | 10 000 cycles<br>Charged to 435 V <sub>DC</sub><br>Discharge resistance:<br>$R = \frac{435 V_{DC}}{1.25 \times C (dU/dt)}$                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4.15.1 Initial measurements     | Capacitance<br>Tangent of loss angle:<br>for $C \leq 1 \mu\text{F}$ at 10 kHz<br>for $C > 1 \mu\text{F}$ at 1 kHz                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4.15.3 Final measurements       | Capacitance<br><br>Tangent of loss angle<br><br>Insulation resistance                                                                                                                                                                   | $ \Delta C/C  \leq 10 \%$ compared to values measured in 4.15.1.<br><br>Increase of tan $\delta$ :<br>$\leq 0.008$ for: $C \leq 1 \mu\text{F}$ or<br>$\leq 0.005$ for: $C > 1 \mu\text{F}$<br>Compared to values measured in 4.15.1.<br><br>$\geq 50 \%$ of values specified in section<br>"Insulation Resistance" of this specification                                                                                         |

| GROUP C INSPECTION REQUIREMENTS         |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SUB-CLAUSE NUMBER AND TEST              | CONDITIONS                                                                                                                                                                                                                                                                                                                                                                                          | PERFORMANCE REQUIREMENTS                                                                                                                                                                                                                                                                                                                                      |
| <b>SUB-GROUP C5</b>                     |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                               |
| 4.16 Radio frequency characteristic     | Resonance frequency                                                                                                                                                                                                                                                                                                                                                                                 | $\geq 0.9$ times the value as specified in section "Resonant Frequency" of this specification.                                                                                                                                                                                                                                                                |
| <b>SUB-GROUP C6</b>                     |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                               |
| 4.17 Passive flammability<br>Class B    | <p>Bore of gas jet: <math>\varnothing 0.5</math> mm<br/> Fuel: butane<br/> Test duration for actual volume V in mm<sup>3</sup>:<br/> V <math>\leq</math> 250: 10 s<br/> 250 &lt; V <math>\leq</math> 500: 20 s<br/> 500 &lt; V <math>\leq</math> 1750: 30 s<br/> V &gt; 1750: 60 s<br/> One flame application</p>  | After removing test flame from capacitor, the capacitor must not continue to burn for more than 10 s. No burning particle must drop from the sample.                                                                                                                                                                                                          |
| <b>SUB-GROUP C7</b>                     |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                               |
| 4.18 Active flammability                | 20 cycles of 2.5 kV discharges on the test capacitor connected to U <sub>RAC</sub> .                                                                                                                                                                                                                                                                                                                | The cheese cloth around the capacitors shall not burn with a flame.<br>No electrical measurements are required.                                                                                                                                                                                                                                               |
| <b>SUB-GROUP ADD1</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                               |
| A.1 Damp heat steady state with voltage | RH: 40 %; temp.: 93 °C, voltage: 300 V <sub>AC</sub><br>Duration: 21 days                                                                                                                                                                                                                                                                                                                           | <p>No visible damage<br/> Legible marking</p> <p><math> \Delta C/C  \leq 10</math> % of the value with initial measurement A.1.1</p> <p>Increase of <math>\tan \delta \leq 0.024</math><br/> Compared to values with initial measurement A.1.1</p> <p><math>\geq 50</math> % of values specified in section "Insulation Resistance" of this specification</p> |
| A.1.1 Initial measurements              | Capacitance<br>Tangent of loss angle: at 10 kHz                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                               |
| A.1.2 Final measurements                | Visual examination                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                               |
|                                         | Capacitance                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                               |
|                                         | Tangent of loss angle                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                               |
|                                         | Insulation resistance                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                               |



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